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EFFECT OF GIBBERELLIC ACID AND NUTRIENTS ON THE GROWTH OF TEAK IN NURSERY. I-POOR PERFORMANCE OF TREATED STUMPS IN THE FIELD

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Introduction

Trial of GA_3 on the growth of 13 species including *Tectona grandis* have been reported (Seth and Mathauda, 1959) indicating positive response in height growth to GA_3 treatments by teak and other species.

Further observations on above trials of GA on the growth of different forest tree species including teak were studied in detail (Dabral and Ghei, 1961). They mentioned that there was positive response to GA_3 treatment during the 1st year of treatment which subsequently reduced the second year even in untreated plants exhibited much better growth during the third year.

Mehrotra and Dadwal (1978) explored the possibility of accelerating growth of teak seedlings in the nursery to transplantable size in the same growing season (i.e. 4½ month, by applying GA, urea and Rallis tracel). However, the growth behaviour of stump prepared from the treated seedlings planted in the field, have not been studied.

In this paper, an experiment conducted to study the effect of GA_3 and nutrients on the growth of teak have been described. The experiment was conducted on the lines as reported by Mehrotra and Dadwal (1978) by adding one treatment of superphosphate with GA_3. Stumps obtained from the treated seedlings were planted at RFRC, site in August, 1978 along with the stumps of average size of untreated seedlings (Normal seedlings of 14 months old) to compare the growth behaviour of stumps obtained from GA/nutrient treated seedlings.

Methodology and Treatments

An experiment to study the effect of GA_3 and nutrients on the growth of teak seedlings was laid out at Barha nursery on 25th May, 1978. Seeds were sown in nursery beds on

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15th April, 1978. There were total 30 subplots of 10 replication each of 1 m×1 m size randomly selected and 3 treatments were as under :

T1—GA_3 100 ppm + urea 0 5% + Rallis tracel* 0.2%

T2—GA_3 100 ppm + urea 0.5% + Rallis tracel 0.2%
+ Superphosphate @ 100 gm/ plot.

T3—Control.

Urea @ 0.5% and Rallis tracel @ 0.2% were sprayed as a foliar spray at weekly interval from 29th May to 1st August, 1978 in treatments T1 and T2, while GA 100 ppm was sprayed only once in these treatments i.e. on 15th June, 1978. In treatment T2 a doze of superphosphate was applied in the middle of June, 1978 @ 100 gm/plot for the root development of the seedlings.

Results and Discussion

In the 3rd week of June, 1978 after the application of GA the ill effects such as chlorosis and reduction in leaf size was observed in the treated seedlings. However, when the treatment of seedlings was followed by the weekly application of urea and Rallis tracel no phytotoxic effect could be discovered and over all growth of the plants increased appreciably. Insect attack was noticed on the foliage of treated seedlings in the 1st week of July, but in untreated seedlings the insect attack was almost negligible. Insecticide (Aldrin) @ 1 ml./litre water was sprayed on the foliage cf all the experimental plots In the 3rd week of July treated seedlings have attained much better height growth in comparison to untreated seedlings. There was proportionate tncrease in root length in treatments T1 & T2 resulting in good root/shoot ratio. In the 1st week of August, 1978 seedlings of different treatments were dug out from the nursery for detailed observations and stumps planting in the field. Observations recorded on 20 seedlings in each treatment i e. shoot length, root length, girth at collar, and two internode distance, similarly observations recorded on 5 seedlings in each treatment i.e. green weight of the plant, fresh and dry weight of root and shoot separately, and have been presented in Table 1.

Field trial of stumps prepared from the treated seedlings at Pariyat site (1977). Stumps obtained from the treated and untreated seedlings were planted at 2 m × 2 m distance at Pariyat site in August, 1977. Thirty stumps per treatment (in 3 replications of 10 each) were used. The preliminary observations taken showed 100% sprouting. (Mehrotra and Dadwal, 1978).

Further study and observations on the above trial was carried out in detail by the authors of this paper. Periodic observations recorded for 2 years on height growth and survival % on seedlings in different treatments have been presented in Table 2.

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*Rallis tracel is a judicious blend of Zinc, Iron, Manganese, Molybdenum, Boron, Magnesium and Sulphur manufactured by Rallis India Limited, Banglore.

Table 1

Effect of GA_3 and nutrients on the growth of teak seedlings in nursery

Treatment	Root length (cm)	Shoot length (cm)	Shoot/root ratio (cm)	Girth at collar (cm)	Two internode distance (cm)	Green* weight (gm)	Fresh* weight (gm)		Dry* weight (gm)	
							Root	Shoot	Root	Shoot
T1–GA 100 ppm +urea 0.5%+ Rallis tracel 0.2%.	44.1	45.2	0.9	3.7	11.7, 10.9	37.2	11.8	25.4	7.6	16.7
T2–GA 100 ppm +urea 0.5%+ Rallis tracel 0.2%+Super-phosphate @ 100 gm/plot.	44.4	40.1	1.1	3.7	10.3, 9.0	39.6	10.0	29.6	7.2	15 1
T3–Control	33.5	15.6	0.43	2.0	3.0, 3.5	9.8	2.6	7.2	1.5	2.1

Figures in the table are the average of 20 seedlings randomly taken from each replication.
* Figures in the table are the average of 5 seedlings in each treatment randomly taken.

Table 2

Average height growth and survival percentage of teak seedlings at Pariyat site (1977)

Treatment	Date of observation				
	March, 1978 Av. ht. (cm)	Sept., 1978 Av. ht. (cm)	March, 1979 Av. ht. (cm)	Dec., 1979 Av. ht. (cm)	Dec., 1971 Survival percentage
T1–urea 0.5%	5.0	18.0	19.0	29.3	70.0
T2–urea 0.5% + Rallis tracel 0.2%	4.8	19.9	20.6	34.2	76.6
T3-GA 100 ppm+urea 0.5%+Rallis tracel 0.2%–GA single doze	5.0	20.1	21.0	33.1	73.3
T4–GA 100 ppm+urea 0.5%+Rallis tracel 0.2%–GA double doze	4.9	20.2	21.2	34.6	70.0
T5–Control	5.1	20.7	21.6	35.4	86.0

It is evident from Table 2 that the average height growth in untreated control treatment was superior than rest of the treatments in each of the observation. Survival percentage was also superior in untreated control treatment than rest of the treatments. From the figures indicated above it is clear that the untreated control treatment was superior both in average height and in survival percentage than rest of the treatments. Since it was a preliminary trial, data could not be statistically analysed.

Field trial of stumps prepared from the treated seedlings at RFRC site (1978). Stumps obtained from treated and untreated seedlings were planted at 2 m×2 m distance at RFRC site in August, 1978. Fifty four stumps (in 3 replications of 18 each) alongwith the normal seedlings of 14 months old have been planted. Periodic observations recorded for 2 years on growth behaviour and survival percentage on seedlings in different treatments have been presented in Table 3.

Table 3

Average height growth and survival percentage of teak seedlings at RFRC site (1978)

Treatment	Date of observation				
	March, 1979 Av. ht. (cm)	Sept., 1979 Av. ht. (cm)	March, 1980 Av. ht (cm)	Dec., 1980 Av. ht. (cm)	Dec., 1980 Survival percentage
T1–GA 100 ppm+urea 0.5% + Rallis tracel 0.2%.	2.7	5.4	7.0	20.9	59.0
T2–GA 100 ppm+urea 0 5% + Rallis tracel 0 2% + Superphosphate @ 100 gm/plot.	2.6	6.3	7.6	22.1	64.8
T3–Control	2.4	5.4	7.6	18.9	40.7
T4 Normal seedlings 14 months old	2.6	6.5	7.8	21.6	55.5

Table 3 indicates that there was no much significant difference in the height growth of treated seedlings over untreated control and normal seedlings of 14 months old. In the normal seedlings of 14 months old, average height growth was superior in September, 1979 and in March, 1980, than the treated seedlings.

Survival percentage of treated seedlings was higher in comparison to untreated and normal seedlings of 14 months old, but it was of no much significance. Due to severe drought in 1979 average height and survival percentage of the seedlings have been affected. Since it was a reliminary trial, data could not be statistically analysed.

Conclusion

The following conclusions can be drawn as a result of the study of various tables :

(i) While the effect of GA in the nursery bed is positive and definitely enhanced the height growth, root growth and vigor of the plant with the help of nutrients.

(ii) The enhanced growth and vigor is suspended with the discontinuation of treatment.

(iii) The enhanced growth and vigor of the treated seedlings does not manifest itself in the performance of the stumps, prepared from the treated seedlings, for planting.

(iv) The effect of GA is only temporary and the performance of the stumps indicate inferior quality and growth as compared to untreated seedlings.

Such conclusions have also been drawn in the growth of teak seedlings by Dabral and Ghei (1961). They have observed when the GA treatment was stopped to the teak seedling the height growth of untreated control seedlings have exhibited higher and superior than the treated seedlings.

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SUMMARY

Effect of GA_3, Urea, Superphosphate and Rallis tracel on the growth of teak seedlings in nursery and its consequent effect after planting the stumps of seedlings in the field was studied. The effect of GA in the nursery bed is positive and enhances the height growth, root growth and vigor of the plants if applied alonwith the nutrients, the enhanced growth and vigor of treated seedlings does not manifest itself in the performance of the stumps, prepared from the treated seedlings for planting in the field. The effect of GA_3 is temporary, and the enhanced growth and vigor of seedlings is suspended with the discontinuation of treatment. The performance of the stumps in the field conditions exhibits inferior quality and growth as compared to the untreated seedlings.

रोपणी में सागौन की वृद्धि पर जिबेरेल्लिक अम्ल और पोष्याहारों का प्रभाव

I—उपचारित ठूंठों की क्षेत्र में घटिया सक्रियता

लेखक वी०आर० नीले व के०एस० नेगी

सारांश

रोपणी में सागौन के पौधों की वृद्धि और पौधों के ठूंठों को क्षेत्रों में रोपण करने के पश्चात् जीए$_3$, यूरिया, सुपरफास्फेट और रल्ली ट्रेसल के उन पर पड़े प्रभाव का अध्ययन किया गया। रोपणी की क्यारी में जीए (जिबेरेल्लिक अम्ल) का प्रभाव धनात्मक रहा और यदि उसका उपयोग पोष्याहारों के साथ किया जाए तो उससे पौधों की ऊंचाई वृद्धि, जड़ों की वृद्धि और ओजस्विता अधिक हो जाती है, उपचारित किये हुए पौधों की बढ़ी हुई वृद्धि और ओजस्विता उन ठूंठों की सक्रियता में नहीं दिखाई पड़ी जिन्हें क्षेत्र रोपण के लिये उपचारित पौधों से तैयार किया गया। जीए$_3$ का प्रभाव थोड़े समय तक रहता है और उपचार बन्द करने पर पौधों की बढ़ी वृद्धि और ओजस्विता भी रुक जाती है। क्षेत्र दशाओं में ठूंटों की सक्रियता गुणों और वृद्धि में अनुपचारित पौधों से भी घटिया दिखाई पड़ी है।

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NOTES ON NURSERY AND REGENERATION TECHNIQUE OF SOME SPECIES OCCURRING IN SOUTHERN TROPICAL WET EVERGREEN AND SEMI-EVERGREEN FORESTS OF KARNATAKA (INDIA)

PART–I

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During recent years, there has been marked public enthusiasm and participation for afforestation programmes, in various countries, all over the world. It is expected that this trend will continue and plantation forestry will get more and more importance in the coming years. The Wet Evergreen and Semi-evergreen forests, which cover the Western Ghats, among other regions of the country are very important from several points of view. There are more than 50 tree species in these forests, with varying degrees of commercial importance. A reliable nursery technique for most of these species has not been established. In the present study nursery and regeneration technique for nine species has been suggested.

Materials Methods

The present study was conducted for a period of one year in three nurseries details of which are given in Table 1.

Table 1

Details of nurseries

Name	Location		Elevation above M.S.L. (m)	Dry months	Soil Type	Remarks
	Lat. (N)	Long. (E)				
Agumbe	13°31′	75°6′	700	January to March	Loam	Rainy season is full of mist. The nursery site is under use since 1962.
Gundia	12°50′	75°30′	150	December to April	Sandy loam	Old Rubber Nursery site.
Sampaje	12°30′	75°34′	150	January to April	Sandy loam	New site.

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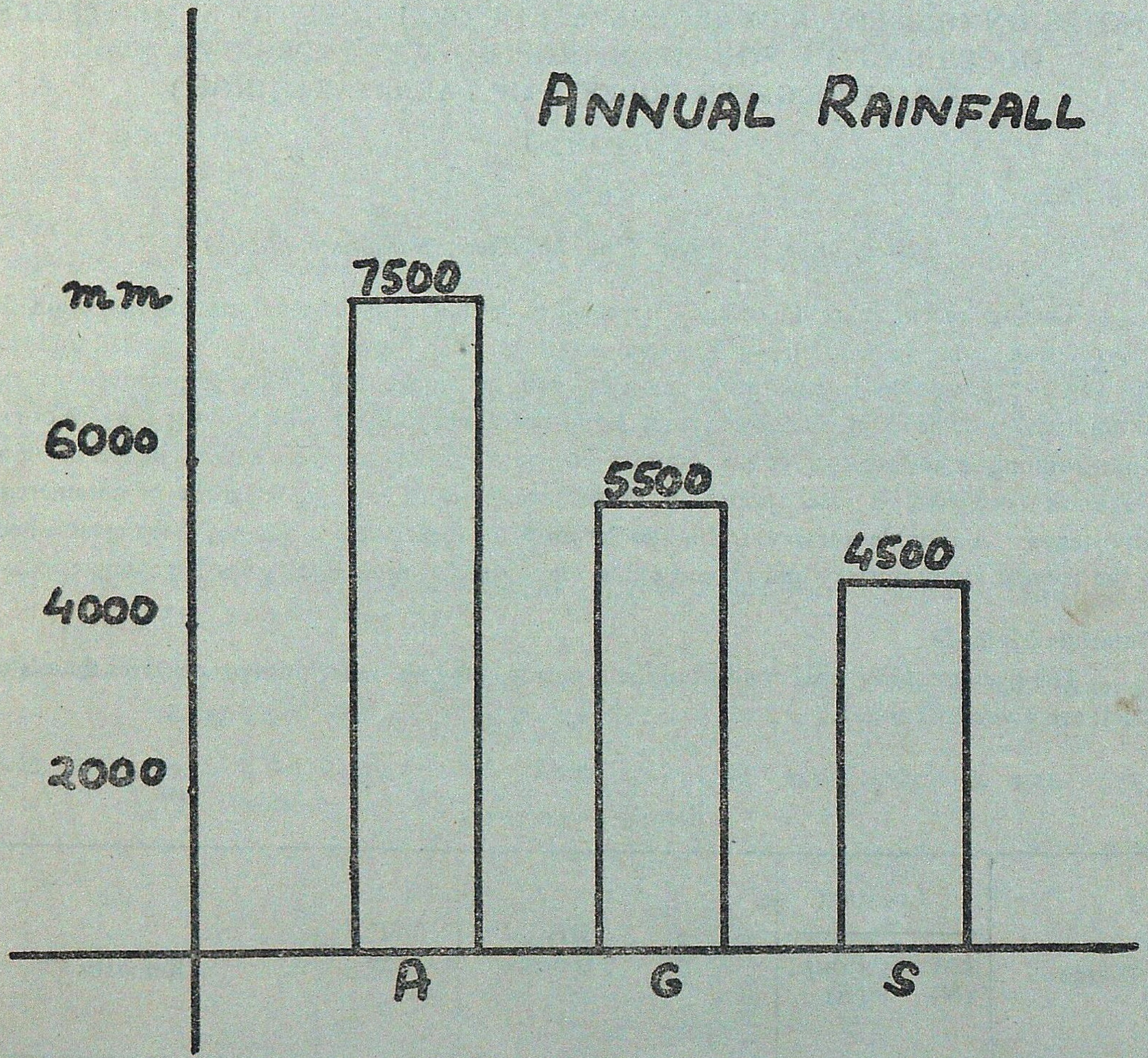
The average annual rainfall for the nurseries is given in Fig. 1. The list of species covered in this study, their phenological and silvicultural characteristics are given in Table 2.

Fig. 1



Average Annual Rainfall in Agumbe, Gundia and Sampaje nurseries.

To determine the average length of shoots and roots, 100 seedlings raised in beds and 30 seedlings raised in polythene containers were selected at random. The seedlings were carefully removed, without damaging the roots. Measurement of shoots and roots was recorded nearest to half a centimeter. The root system of the species has been described.

Results and Discussion

A—*growth.* The rate of growth obtained in the three nurseries is given in Table 3, along with certain other observations.

Table 2

Information on seed and nursery

Species	Fruit Ripening	Seed Wt. (kg)	Viability	Period of germination	Percentage germination	Direct sowing/ Germination bed.	Remarks
1	2	3	4	5	6	7	8
Callophyllum elatum	July-August	150	6 months	3 to 5 months	60%	Direct sowing or Germination Bed	Sowing of freshly collected seed gives better result. Sown 5 cm apart and prickedout in polybags. Overhead shade is necessary.
Canarium strictum	Oct.-Nov.	120	6 months	2 to 4 months	80%	Direct sowing	Fruit is soaked in water for 3-4 days and washed thoroughly to remove the pericarp. Cotyledonary leaves are conspicuously different from other leaves. Seedlings require overhead shade. Sown in beds/bags 10 cm apart.
Dipterocarpus turbinatus	May-June	150	15 days	3 to 10 days	90%	,,	Sowing is done in shaded beds or polybags 10 cm apart. Seedlings require light overhead shade.

(Contd...)

1	2	3	4	5	6	7	8
Elaeocarpus tuberculatus	May–August	500	2 months	3 weeks to 2 months.	60%	Direct sowing	Sown 5 cm apart. Better to raise polybag seedlings. Seedlings require overhead shade during summer months.
Hopea parviflora	April–June	2500	20 days	10 days to 20 days	90%	,,	Sown in bed or bag 5 cm apart.
Lophopetalum wightianum	May–June	4000	3 weeks	3 days to 10 days	90%	,,	Seedling can be raised in beds and planted naked. Sowing of seed in done 5 cm apart.
Mesua ferrea	Sept.–Dec.	270	1 year	3 weeks to 1 year.	90%	,,	Young seedlings are very tender. They do not stand pricking out.
Persia macrantha	Feb.–March	2000	1 month	15 to 25 days	80%	,,	Sown 5 cm apart. It is possible to prick out the seedlings. They require overhead shade during summer months.
Vateria indica.	June–July	55	3 weeks	3 days to 3 weeks.	30%	,,	Seed covered with leaf litter gives better germination, than the one covered with soil.

(A = Agumbe, G = Gundia, S = Sampaje)

Table 3

Rate of growth of seedlings in the nurseries.

Species	Nursery	Age of seedlings (days)	Av. length (cms)		Raised Bed/ Polythene bag.	Remarks
			Root	Shoot		
Callophyllum elatum	A	290	22.4	14.5	R.B.	Growth of root is faster than the shoot
Canarium strictum	--	430	30.40	50.60	R.B.	This is based on experience and field observations.
Dipterocarpus turbinatus	--	365	30.40	50.60	R.B.	This is based on experience and field observations.
Elaeocarpus tuberculatus	S A	325 356	24.8 19.1	54.6 32.9	R B. R.B.	Growth in Sampaje nursery, where the soil is sandy loam is better than Agumbe where the soil is clayey.
Hopea parviflora	--	365	30.35	40.50	R.B.	This is based on experience and field observations.
Lophopetalum wightianum	A	276	17.4	10.9	R.B.	Polybag seems unsuitable for raising seedlings. Better growth (Average 50 cm. shoot and 30 cm root) has been seen in raised beds.
Mesua ferrea	A (i) (ii)	287 287	21.6 19.0	17.0 14.8	R.B. P.B.	Growth in raised beds is better. In both the cases root is faster grown than the shoot.
Persia macrantha	A S	135 135	11.5 33.4	12.7 55.7	R.B. R.B.	Here again growth on sandy loam soil is better than on loamy soil.
Vateria indica	A (i) G S	370 359 399	20.3 63.7 59.2	13.9 84.3 121.7	P.B. R.B. R.B.	In smaller seedling root shoot ratio is narrow. Growth of seedlings in Agumbe nursery is conspicuously poorer than in the other two nurseries.

(A = Agumbe, G = Gundia, S = Sampaje.)

B—*Fruiting Behaviour, Seedling and its Root*. Details in respect of fruiting and seedling with particular reference to type of root is given below for the nine species.

(i) *Callophyllum elatum*, Bedd. It seeds almost every year. Seed can be collected below the mother trees or by lopping. It is better to depulp the fruit after collection. Seed is sown in the germination bed and covered with soil. Seedlings remain in cotyledonary leaf stage for 10-15 days. The seedling is pricked out in polybags The seedlings are slow growing and may reach only upto 40 cm in one year. The tap root is strong and crooked. It is slightly thicker than the stem. There is a scar and an angular projection in the collar region; the mark left by the fallen cotyledons. The cotyledons remain attached to the collar for about 5 to 6 months. Secondary roots are very few and small. The tap root takes a slight bend near the collar. The tap root is as long as or longer than the shoot in young seedlings.

(ii) *Canarium strictum*, Roxb. Almost all the trees bear fruit once every year. Fruit ripens from October onwards and remains on tree till February, when the tree refoliates. The fruit can be collected from or below the trees. The fruit has a very hard seed coat and contains oily endocarp. It is desirable to dibble the seed in shaded polybags and keep on watering regularly. The seedlings remains in cotyledonary leaf stage for 2 to 3 weeks. The tap root is prominent and invariably as thick as the stem for some length. Just below the collar there is a bend in the root. The tap root is knotty and crooked. From the knotty spots thicker secondary roots originate. Secondary roots are seen all over.

(iii) *Dipterocarpus turbinatus*, Gaertn. Fruiting is irregular. In certain localities alternate years are good seed years. Ripening of fruits is a fortnight earlier in the southern part of Western Ghats. Seed contains oil and is attacked by insects. It can be collected below the mother trees. The seed fallen on the ground start germinating within two to three days, provided adequate moisture is available. While sowing, the seed is covered with soil and wings remain sticking out. The covered seed is free from insect damage. The germinating seed sends out a strong root, both under natural conditions and also in the nursery. The forest floor has a layer of undecomposed litter and it appears till the young root penetrates this layer and hits the soil below, the shoot development does not take place. Wherever, the layer of the litter is a little too thick and the tap root of the seedlings does not go sufficiently deep into the soil, the seedlings dry up during the summer months. The tap root usually becomes crooked in growth. Secondary roots are very thin and few in number.

(iv) *Elaeocarpus tuberculatus*, Roxb. The tree bears fruit almost every year. The trees in open bear profusely There is marked difference in ripening time of fruits between the areas around Madikeri (Mercarà) and Agumbe. Around Madikeri the fruit ripens during May-June, while around Agumbe, it ripens during July-August The ripening fruit is collected from the tree and stored in a heap for three to four days, when the pulp is removed by washing and the seed is dried in shade. The seeds collected from ground, which are damaged by insects fail to germinate. The seedlings remain in cotyledonary leaf stage far nearly three to four weeks. The root system is well developed. Generally the tap root branches off into

two or three. Other secondary roots are numerous and are seen spreading in all directions. The secondary roots branch further and give rise to still larger number of tertiary roots.

(v) *Hopea parviflora* Bedd. Fruiting is abudant almost every year. The fruit ripens during April-June. In certain localities of Dakshin Kannada (South Kanara), where one finds almost pure growth of the species, at low elevations of 100-150 m the ripening of fruits is early, while around Agumbe, where the species is found as an associate of *Dipterocarpus turbinatus*, at higher elevations (700 m), the ripening of fruits is late Germination starts within a week after the fruit has fallen on the ground, provided adequate moisture is available. The fruits are prone to be attacked by insects and therefore, should be collected every-day from the ground, or ripe fruits can be collected by lopping the branches. Seedlings can be raised in nursery beds from freshly collected seed. Overhead shade is necessary only in the initial stages. The seedlings come up well in polybags also. The tap root is strong and crooked in growth. It is as thick as the stem for some length. Tapering is gradual. After some age the tap root branches off. Numerous small secondary roots spread laterally.

(vi) *Lophopetalum wightianum*, Arn. Fruiting is abundant every year. The fruit ripens during May-June. The seed can be collected below the mother trees (this seed has to be directly sown in the bed) or by lopping the branches for ripe fruits and spreading them in sun to dehisce. The seed collected from the tree can be stored for about a week. Freshly collected seed is sown in the bed or polybags. Root growth is fairly fast in the raised beds. It is desirable to raise the seedlings, in polybags. The tap root is crooked. It starts tapering from collar region. Secondary roots are not very prominent, but the few which are seen, have fine tertiary roots. The roots of young seedlings are longer than the shoot. The colour of the root is yellowish.

(vii) *Mesua ferrea*, Linn. Seedling is irregular; in certain localities good seed year is once in two, three or four years. In certral and northern parts of Western Ghats in Karnataka, the fruit ripens during September-October, while in Kodagu (Coo g) and adjoining areas in the Southern part of the State, it ripens during November-December. Ripe fruits are collected from the ground or from the tree It is dried and allowed to dehisce. Seed is oily and attacked by insects. Freshly collected seed is sown in beds or polybags. The seed is covered by a thin layer of earth. The seedlings remain with cotyledonary leaves for three to four weeks. Growth of seedlings in the initial stages is slow. The seed sends out a strong root while germinating. The tap root grow straight. There is a scar, the mark left by the cotyledons, in the collar region. The tap root is generally thicker and longer than the shoot in young seedling. Secondary roots are nearer the collar region, they are thick and branchy. Spread of the secondary roots near the collar is lateral.

(viii) *Persia macrantha* (Mees) Kosterm Almost all the trees bear fruit every year. The seed is collected from or below the trees. Growth of seedlings under shade is faster. The tap root is prominent and strong. It is slightly thicker than the stem for some length. The tap root is straight and without prominent secondary roots. The secondary roots originating near the collar region are long, thin and spread laterally. The root is dust coloured.

(ix) *Vateria indica,* Linn. Alternate years are good seed years. Trees with exposed crown bear profusely at the branch tips. In southern parts of Karnataka the ripening of fruits is earlier by a fortnight or even more. Best way to collect fruits is from below the mother trees. Fallen fruits are attacked by insects, which feed on the kernel. Hence fresh collections are preferable. Even the insect-eaten fruits produce seedlings. It has been observed in the nurseries that certain amount of decomposing litter ensures good germination. May be the roots are adapted to get their nutrition from decomposing litter. The germinating seed sends out a strong tap root, which is 15–20 cm long within a week. The tap root is strong and thicker than the stem. Collar portion is marked conspiciously by a scar, in the shape of a protruding ring, left by the fallen cotyledons This scar is clearly seen even after one year. From this point downwards the root starts thickening and becomes slightly tuberous in appearance. Tapering of the root is gradual. Secondary roots are thin, small and few in number.

C—*Distribution and Natural Regeneration.* Regeneration of *Callophyllum elatum* is adequate in the localities where its distribution is low (below 2% approx.), but it is inadequate in the areas where it occurs more frequently.

Canarium strictum is found scattered in the evergreen and semi-evergreen forest. Nothing clearly indicates its preference for locality. Regeneration is inadequate. The species has very good coppicing vigour in sapling stage.

Regeneration of *Dipterocarpus turbinatus,* in naturally created openings is adequate. Profuse regeneration is seen in patches where lateral shade is available. The seedlings under lateral shade have better vigour and growth than those coming under full shade. The species goes on progressively decreasing in the floristic composition of the forests from South to North in the Western Ghats of the State. The saplings have good coppicing vigour.

Elaeocarpus tuberculatus prefers moist localities, particularly sites with colluvial soil. In such patches it comes up gregariously and regenerates adequately, elsewhere the regeneration is poor.

Hopea parviflora has profuse natural regeneration, in the localities where biotic interferences are limited. The regeneration suffers due to trampling. In fact in certain localities the regeneration is profuse. The species occurs gregariously in Dakshin Kannada (South Kanara) District.

Natural regeneration of *Lophopetalum wightianum* is inadequate. In the beginning of the rainy season, profuse regeneration is seen below the mother trees, but as the seedlings are very tender, the establishment is poor. The specie prefers moist localities (stream banks etc.) in the evergreen forests. This is one of the fastest growing species of these forests.

Natural regeneration of *Messua ferrea* is inadequate. The seeds fallen on the ground, if they escape insect damage and remain in contact with soil and covered with litter,

germinate during October–November, practically after one year, but this percentage is very low as only few seedlings are seen below the mother trees. The seedlings show alternate alongation and consolidation, which is a characteristic feature of many tropical evergreen species. The seedlings need overhead light after their initial requirement of shade. The saplings have good coppicing vigour.

Natural regeneration of *Persia macrantha* is inadequate, may be because it is easily browsed. It prefers cooler localities.

Regeneration of *Vateria indica* is profuse. The species occurs gregariously on the alluvial formations and also along the streams. In a good seed year the regeneration below the mother trees is abundant during rainy season, but this survives only on sites where moisture is available during dry months.

D—*Artificial Regeneration. Callophyllum elatum* seedlings are quite slow growing. Seedlings raised in containers may be planted under lateral shade in suitable localities. Transplanting of naked seedlings is not successful.

Canarium strictum seedlings can be planted naked with negligible success. An attempt to prick out seedlings to polybags resulted in complete failure. It is preferable to plant container raised seedling under lateral shade. Seedlings planted under deciduous overwood are growing, vigourously.

Root growth of *Dipterocarpus turbinatus* seedlings is initially very fast. Transplating of naked seedlings is a failure. Pricking out of seedlings is also not successful. Dibbling of seed and planting of seedlings raised in container under lateral shade is successful.

Elaeocarpus tuberculatus seedlings can be planted naked but it is better to plant container raised seedlings. Artificial regeneration of *Hopea parviflora* by dibbling of seed has given good results (attempts made in South Kanara around 1920). Planting of naked seedlings is successful. Seedlings need shade initially, but grow faster in open after establishment.

Planting of naked seedlings of *Lophopetalum wightianum* is partly successful. It is preferable to plant container raised seedlings under partial shade. After initial years the specie prefers overhead light.

Planting of naked seedlings of *Masua ferrea* is not successful. It is better to plant container raised seedlings, under moderate shade.

Successful regeneration of *Persia macarantha* is possible by planting naked seedlings under moderate lateral shade.

Best method of artificial regeneration of *Vateria indica* is by dibbling the seed. Where absolutely necessary container raised seedlings may be used as an alternative. This problem may arise as there is marked alternate bearing in this specie. Planting of naked seedlings is a failure.

SUMMARY

Nursery and regeneration technique of nine species of Southern Tropical Wet Evergreen and Semi-evergreen Forests of Karnataka (India) has been suggested. The study was conducted in three nurseries located at different places, with different soil and rainfall. Length of roots and shoots of seedlings, selected at random, has been recorded. The root system of seedlings has been studied and described. A brief description of fruiting behaviour, Seed collection and handling, Natural and Artificial regeneration and the distribution of the species is also given. The species covered in the present study are ***Callophyllum elatum, Canarium strictum, Dipterocarpus turbinatus, Elaeocarpus tuberculatus, Hopea parviflora, Lophopetalum wightianum, Mesua ferrea, Persia macrantha*** **and** ***Vateria indica.***

कर्णाटक (भारत) के दक्षिणी उष्ण आर्द्र सदाहरित और अर्द्ध सदाहरित वनों में होने वाली कुछ वृक्ष जातियों की रोपणी और पुनर्जनन विधि के सम्बन्ध में कुछ टिप्पणी

भाग–I

लेखक एस०एन० राय

सारांश

कर्णाटक (भारत) के दक्षिणी उष्ण आर्द्र सदाहरित और अर्द्ध सदाहरित वनों की नौ वृक्ष जातियों की रोपणी और पुनर्जनन विधि के सम्बन्ध में कुछ सुझाव दिये गये हैं। यह अध्ययन भिन्न-भिन्न मृदाओं और वर्षा वाले भिन्न-भिन्न स्थानों पर बनाई हुई तीन रोपणियों में किया गया। पौधों की जड़ और प्ररोह की लम्बाई यादृच्छिक ढंग से लेकर आलेखित की गई। पौधों की जड़ प्रणाली का अध्ययन किया गया तथा उसका वर्णन दिया गया है। फलने का ढंग, बीज संग्रह और उसका उठाव-धराव, प्राकृतिक और कृत्रिम पुनर्जनन और वृक्ष जातियों का विस्तार बताए गये हैं। इस अध्ययन में ये वृक्ष जातियां ली गई हैं—कैलोफायलम इलेटम, कैनेरियम स्ट्रिक्टम, डिप्टेरोकार्पस टर्बिनेटस, इलियोकार्पस ट्यूबरक्युलेटस, होपिया पार्विफ्लोरा, लोपोपिटेलम वाइटियानम, मेसुआ फेरिया, पर्सिया मैक्रेन्धा और वैटीरिया इण्डिका।

PROVISIONAL GROWTH ESTIMATE OF *LAGERSTROEMIA HYPOLEUCA* (PYINMA)

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Lagerstroemia hypoleuca (Pyinma) is a large deciduous tree which is principal species of Andamans occurring chiefly in dry deciduous forests. In West Bengal, it is considered to be suitable for sowing on wet low lying land.

It is a fast growing species, but has a tendency to branch low on account of this, it should be grown at a close spacing to start with. It is a very good coppicer.

Data to determine species dependent coefficients of growth model were derived from 28 sample plots mentioned hereunder—

	S. Plot No.
Aandamans Division	11 to 17, 24, 26 & 41
Kurseong Division	32 (Nine plots) & 33 (Nine plots)

In all there were 37 measurements. Due to paucity of data, this study should be treated as *provisional*. Mean and standard deviation of basic parameters used are given as follows to indicate size and range of data.

Parameter	Mean	Standard deviation	Denoted in text by	Units
Age	7.3	3.6	A	year
Top height	12.3	3.0	H	m
Total volume/ha (before thinning)	82.35	59.13	V2+V4	m^3
Basal area/ha (before thinning)	15.20	5.58	BA	m^2
Basal area ratio	0.765	0.154	$ER=BA/BA_{Maz}$	—
Number of trees/ha (before thinning)	2855	1787	S1+S2	—
Height ratio	0.982	0 074	HR=(H/Mean height from curve)	—

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A perusal of standard deviation of Height ratio indicates that there is not much variation in Top height for the same age. Hence no attempt will be made to distinguish site qualities.

Methodology

Following relationships were developed. These relationships are valid for the range covered in basic data.

1. *Site quality function*

$$\text{Log}_e\ H = 13.26638 - 11.83442/A^{.05}$$

2. *Crop diameter function*

$$\text{Log (D2)} = (3.10407 - 1.81967\ BR^2 - .50850\ HR)\ \text{Log}_e\ H + 4.34587\ BR^3 - 8.84498$$

Multiple correlation coefficient $(r) = .834$

Where D2 is mean crop diameter before thinning.

3. *Volume functions*

(a) $V2+V4 = (1.43448\ BR^{-.3} - 1.03392\ HR)\ BA.\ H + 71.94145\ HR^2 - 56.70381\ ER^{-.6} - 24.27104$

$r = .987$

(b) $\text{Log}_e\ (V2/(V2+V4)) = .36945\ \text{Log}_e\ (S1/(S1+S2)) + .43299\ HR - .46092$

$r = .759$

Where V2 is total volume/ha after thinning.

Equation (b) is aimed to reduce standing is volume before thinning to standing volume after thinning. The correlation coefficient of this regression is not high These figures could not be improved significantly by adding more variables. Probably in thinnings, the removal of thinning has not followed any systematic pattern (i e. low thinning, mechanical or crown thinning) and hence this situation. Therefore, crop volume value will be more reliable than volume after thinnings generated in growth tables.

4. *Maximum basal area curve.* Graph between Top height and basal area/ha was p otted. Freehand curve was drawn to cover the maximum observed values (BA_{Max}). Suitable function to fit points taken from hand drawn curve was found.

$$\text{Log}_e\ (BA_{Max}) = 3.54729 + 2.35298\ \text{Log}_e\ \left(1 - e^{-.12729\ H}\right)$$

Top height corresponds to the height of a tree of top diameter, where top diameter is mean diameter of 125 thickest trees/ha.

Maximum basal area curve helps to define capacity of soil and provides a check against simulating unrealistic values. The yield tables is generated as under from these regressions for

mean quality class (HR=1) and for maximum yie'd capacity (BR=1). Attempt is not made to estimated values at age higher than 15 years to restrict simulation within limits of data.

Age (yrs)	Top height (m)	Crop diameter	No. of trees/ha	Basal area per ha (m^2)	Volume/ha (m^3) Total wood	Thinning volume (m^3) Total wood	M.A.I. (m^3) Total wood
1	2	3	4	5	6	7	8
5	10.5	0.069	4530	16 946	66.305	6.977	13.261
10	15 2	0.092	3616	24.051	146 755	13.221	15.273
15	18.7	0.108	3015	27.629	209.727	—	15.328

Col. 3 to 6 pertain to before thinning values.

Conclusion

The mean annual increment of *Lagerstroemia hypoleuca* is 15.3 m^3 for mean site at an age of 15 years which appears very near to rotation for harvest for maximum volume production. The table reveals that to obtain high annual yield, the stocking is also very high. In situations where the aim is to produce quality timber, the strategy would be different in which a sharp reduction in stocking with passage of time may be required which in turn will force rotation age to a much higher value.

In high rainfall areas where undisturbed natural forests put on meagre increment, such species which are dominating in initial growth hold great promise.

SUMMARY

Information on growth of *Lagerstroemia hypoleuca* (Pyinma) is scanty and no attempt was made to estimate period of harvest for this species. Though the growth data is limited, yet attempt is made to study its growth pattern and project the same in the form of yield table.

लैगरस्ट्रोमिया हाइपोल्यूका (प्यिनमा) की वृद्धि का अन्तरिम अनुमान

लेखक एस०पी० सिंह व आर०एस० शर्मा

सारांश

लैगरस्ट्रोमिया हाइपोल्यूका (प्यिनमा) की वृद्धि के सम्बन्ध में वहुत कम जानकारी मिलती है और इस जाति की फसल कटाई की अवधि का अनुमान लगाने का कोई प्रयास भी नहीं किया गया। इसकी वृद्धि के आंकड़े बहुत सीमित हैं। तथापि इसकी वृद्धि के ढ़ंग का अध्ययन करने का प्रयत्न और उसे प्राप्ति सारणी के रूप में देने का यह उपक्रम किया गया है।

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DISTRIBUTION AND GROWTH OF WEEDS AS INFLUENCED BY INTENSITY OF FELLING IN SPRUCE AND SILVER FIR FORESTS

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Introduction

The natural regeneratian of spruce and silver fir in north-west Himalayas continues to be a problem. Thick and tall weed growth has been reported to be one of the important factors inhibiting natural regeneration of these species (Troup, 1921; Glover, 1936; Kaushik, 1954; Datta, 1958; Dhillon, 1961; Sufi, 1970). The weeds compete with spruce and silver fir seedlings for available moisture and nutrients, shut out light and thus suppress and kill the seedlings. Tall weeds when flattened with the weight of snow during winter, cover the seedlings and at times break and smother them. The density, height growth and nature of root system of the weeds affect the establishment and growth of natural regeneration in the forests. Though weed growth is affected by a number of factors the amount of light reaching the forest floor is one of the most important factors affecting the weed growth. The intensity of light on the forest floor is determined by the intensity of felling. Investigations were, therefore, undertaken to study the distribution and growth of weeds in spruce and silver fir forests as affected by the intensity of felling,

Materials and Methods

These studies were conducted in areas worked under selection, shelter-wood uniform and clear-cutting systems. The studies in forests worked under selection and shelter-wood uniform systems were carried out at Chhachpur while those in the areas worked under clear-cutting system were carried out at Chhachpur and Narkanda.

The forests of the experimental areas have been described in respective working plans (Upadhay, 1963; Sharma, 1966). In the forests worked under selection system, selection-cum-improvement fellings as prescribed in the above working plans have been carried out. In areas worked under shelter-wood uniform system, fellings have been carried out so as to leave about 80-100 trees per hectare and the areas worked have been planted with silver fir. The prescriptions for clear-cutting system included felling of all the coniferous trees except the poles up to 40 cm in diameter which were generally absent in these areas. Fellings carried out amounted to clear-cutting in most of these areas and the same have, therefore, been referred to as clear-cutting in this paper. The forests worked under selection, shelter-wood uniform and clear-cutting systems will hereafter be referred to as selection, shelter-wood and clear-cut areas in this paper.

Spruce and silver fir forests of Chhachpur are situated at an elevation varying from about 2,400 m to 3,300 m and on northern and north-western aspects. The slope is moderate. The soil and humus of these forests have been described by Verma (1973). The study area at Narkanda is situated at an elevation of about 2,200 m to 2,400 m and on northern and north-eastern aspects. The soil and humus characteristics of these forests have been described by Dhir (1967 & 1971).

In each of the three types of areas at Chhachpur, two sample plots (25 × 20 m each) were laid out at random. In each sample plot, studies with regard to weed distribution and growth were carried out in 10 quadrats (1 m^2 each) chosen at random. The frequency classification adopted was as follows : abundant (A), > 80%; dominant (D), 61–80%; frequent (F), 41—60%; occasional (O), 21–40%; rare (R), < 20%;

Besides distribution, the biomass of weeds was also studied. Three quadrats were taken at random in each sample plot for biomass studies. All the weeds in a quadrat were uprooted. The plants of the predominant weed species in each quadrat were separated out and those of the remaining species were kept together. The root and shoot portions of each of these two categories were bagged separately and their green weights were determined on Avery balance capable of weighing to an accuracy of 1 g. The samples were then ovendried at 85°C for 48 hours and their dry weights were recorded.

Results

Weed distribution. On the basis of frequency distribution, the weed composition in different types of study areas emerged as summarized in Table 1.

As is clear, *Fargaria indica* is a common weed in all these forests. Admission of more light on the forest floor through felling of trees changes the weed composition. Weeds like *Strobilanthes atropurpureus*, *Polygonum* sp., *Impatiens balsamina* and *Onychium* sp. make their appearance as more light is admitted on the forest floor. *Polygonum* sp. and *S. atropurpureus*, which are generally absent in selection forests, are frequently found in shelter-wood forests and become dominant and abundant in clear-cut areas. *Impatiens balsamina* which is generally absent in selection forests, is occasionally found in shelter-wood forests and is quite frequent in clear-cut areas.

Weed biomass. Mean above, below ground and total biomass of weeds in selection shelter-wood and clear-cut areas is summarized in Table 2.

The weed biomass generally increased with an increase in the intensity of felling and was the highest in clear-cut areas.

The comparative increase in weed biomass in shelter-wood and clear-cut areas as compared to selection forests (taking it as 100) is as summarized in Table 3.

Table 1

Weed Composition in different types of areas

Locality	Type of area	Weeds recorded				
		Abundant	Dominant	Frequent	Occasional	Rare
1	2	3	4	5	6	7
Chhachpur	Selection	*Fragaria indica*	*Adiantum* sp., *Angiopteris* sp., *Valeriana wallichii*	*Prenanthes brunoniana, Rumex nepalensis*	*Cynodon dactylon, Impatiens balsamina, Rununculus hirtellus, Swertia cordata*	*Cypercus aristatus, Sarcococca pruniformis, Senecio* sp., *Thalictrum javanicum*
	Shelter-wood	*Fragaria indica*	*Ranunculus hirtellus, Rumex nepalensis*	*Polygonum* sp., *Strobilanthes atropurpureus, Valeriana wallichii*	*Cynodon dactylon, Impatiens balsamina, Thalictrum javanicum, Ajuga bracteosa*	*Athyrium* sp. (fern), *Cyperus aristatus, Foeniculum vulgare, Prenanthes brunoniana, Sarcococca pruniformis, Swertia cordata*

(*Contd...*)

1	2	3	4	5	6	7
	Clear-cut	*Fragaria indica, Strobilanthes atropurpureus*	*Polygonum* sp.,	*Impatiens balsamina, Swertia cordata*	*Athyrium* sp., *(fern), Geranium nepalensis*	*Cyperus aristatus, Foeniculum vulgare, Onychium* sp., *Ranunculus hirtellus, Thalictrum javanicum*
Narkanda	Clear-cut	*Fragaria indica*	*Galium* sp., *Geranium nepalense, Impatiens balsamina, Onychium* sp., *Strobilanthes* sp., *Trifolium* sp.	*Athyrium* sp., *Polygonum* sp., *Ranunculus hirtellus, Salvia glutinosa, Viola* sp.	*Adiantum* sp., *Ajuga bracteosa, Arisaema* sp., *Cynodon dactylon, Cyperus aristatus, Foeniculum vulgare, Prinsepia* sp., *Swertia cordata, Sarcococca pruniformis*	*Angiopteris* sp., *Aster* sp., *Daphne* sp., *Epilobium* sp., *Hedera helix, Thalictrum javanicum.*

Table 2

Mean weed biomass (g/m_2) in different types of forest areas

Locality	Type of area		Weed biomass		
			above ground	Below ground	Total
Chhachpur	Selection	Min	35.0	30.0	
		Max	190.0	365.0	
		Mean	92.9	194.2	287.1
	Shelter-wood	Min	80.0	95.0	
		Max	220.0	530.0	
		Mean	130.0	326.7	456.7
	Clear-cut	Min	135.3	445.0	
		Max	720.0	1090.0	
		Mean	394.0	712.0	1106.0
Narkanda	Clear-cut	Min	95.0	60.0	
		Max	355.0	585.0	
		Mean	205.8	264.4	470.2

Table 3

Comparative figures of weed biomass in different types af areas

Locality	Type of area	Comparative increase over selection forests		
		Above ground weed biomass	Below ground weed biomass	Total weed biomass
Chhachpur	Selection	100.00	100.00	100.00
	Shelter-wood	139.86	168.24	165.05
	Clear-cut	423.88	366.68	399.35

The total weed biomass in clear-cut areas was 4 and 2.4 times that in selection and shelter-wood forests respectively; the percentage increase in case of above ground biomass of weeds in clear-cut areas was more than that of the total weed biomass.

The proportion of above and below ground biomass and the root shoot ratio of the importants weeds is summarized in Table 4.

Table 4

Proportion of above and below ground biomass and root/shoot ratio of weeds

Weeds	Percentage of biomass		Root/Shoot ratio
	Above ground	Below ground	
Angiopteris sp.	23.44	76.56	3.27
Fragaria indica	36.67	61.33	1.67
Impatiens balsamina	80.85	19.15	0.24
Onchyium sp.	29.84	70.16	2.35
Polygonum sp.	28.85	71.15	2.47
Ranunculus hirtellus	63.64	30.36	0.48
Rumex nepalensis	13.39	86.61	6.47
Salvia glutinosa	67.47	32.53	0.48
Sarcococca sp.	35.63	64.37	1.81
Strobilanthes atropurpureus	37.62	62.38	1.66
Swertia cordata	90.00	10.00	0.11

The below ground biomass is more than the above ground biomass for most of the weeds except *Impatiens balsamina*, *Ranunculus hirtellus*, *Salvia glutinosa* and *Swertia cordata*. Most of the weeds of spruce and silver fir zone, thus, have perennial root system. The aerial parts of such weeds die every year while the root is perennial and accretion continues as evidenced by high root : shoot ratio in *Rumex nepalensis*, *Angiopteris* sp., *Polygonum* sp., *Onychium* sp., and *Strobilanthes atropurpureus*.

The above ground biomass is related to height and diameter of plants which for important weeds are summarized in Table 5.

Table 5

Weeds	Mean height (cm)	Mean collar diameter (cm)
Angiopteris sp.	56.0	0.23
Fragaria indica	13.5	0.09
Impatiens balsamina	71.0	0.53
Onychium sp.	25.6	0.31
Polygonum sp.	37.0	0.33
Ranunculus hirtellus	38.0	0.29
Rumex nepalensis	19.0	0.31
Salvia glutinosa	107.5	0.99
Sarcococca sp.	28.0	0.45
Strobilanthes atropurpureus	72.5	0.96
Swertia cordata	45.0	0.43

SUMMARY

The results of a study on the distribution and growth of weeds in spruce and silver fir forests worked under selection, shelter-wood uniform and clear-cutting systems are presented. The composition and relative dominance of weeds changed with the intensity of fellings. The density and growth of weeds was the least in selection forests and the highest in areas worked under clear-cutting system; areas worked under shelter-wood uniform system were intermediate in this respect. Total weed biomass in clear-cut areas was 4 and 2.4 times that in those worked under selection and shelter-wood uniform systems respectively. Most of the weeds whose growth is encouraged by heavier fellings grow tall and luxuriant and are harmful to the regeneration of spruce and silver fir.

प्रसरल और रजत तालाशपत्र वनों में पातन करने की चण्डता से प्रभावित होने पर
खरपतवार का विस्तार और वृद्धि

लेखक आर०वी० सिंह, के०सी० शर्मा व के०सी० गुप्त

सारांश

इस अभिपत्र में प्रवरण प्रणाली, रक्षिवितान समरूप प्रणाली और निश्शेष पातन प्रणाली द्वारा काम कराए गए प्रसरल और रजत तालीशपत्र वनों में खरपतवार के विस्तार और उसकी वृद्धि के परिणामों को प्रस्तुत किया गया है। खरपतवार के गठन और आपेक्षिक अधिरोहिता में पातन करने की चण्डता के साथ परिवर्तन हुआ। खरपतवार की सघनता और वृद्धि सबसे कम प्रवरण वनों में और सबसे अधिक निश्शेष पातन प्रणाली से काम कराए वनों में रही। रक्षिवितान समरूप प्रणाली पर काम कराए वन इस विचार से इनके मध्य पड़ते हैं। निश्शेष पातित क्षेत्रों में खरपतवार का कुल जेवपुंज प्रवरण और रक्षिवितान समरूप प्रणाली पर काम कराए वनों की तुलना में क्रमशः 4 और 2.4 गुना रहा। बहुत सारे खरपतवार (तृणक) जिनकी वृद्धि अधिक भारी पातन से प्रोत्साहित होती है, अधिक लम्बे और घने हो जाते हैं और प्रसरल और रजत तालीशपत्र के पुनर्जनन को हानि पहुंचाते हैं।

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A PRELIMINARY SURVEY OF *MYRTACEOUS TAXA* OCCURRING IN INDIA

A CHECK-LIST

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Hooker (1878) described 156 species under 10 genera from the Indian and sub-continent. Later Botanists (Kanjilal and Das, 1938; Cook, 1958*; Duthie, 1960*; Haines, 1961*; Gamble, 1967*) have contributed towards the account of *Myrtaceous taxa* from different states of India. Merrill and Perry (1938) studied in detail the taxonomy of the the Indo-Chinese species of *Syzygium* Gaertn. Recently, Hara and his associates (1966, 1971, 1975) have described three genera *Eugenia, Psidium* and *Syzygium* with one species under each from the region of Eastern Himalaya. Santapau (1967) recorded 6 species under four genera, such as, *Syzygium, Eucalyptus, Psidium* and *Myrtus* from different parts of the Western Ghats. Nair (1978) described seven species under four different genera, such as, *Eucalyptus, Syzygium, Psidium* and *Callistemon* from the Punjab plains i.e. Haryana and Punjab States of India. In the present communication, 14 genera and 117 species are found to be distributed in the family Myrtaceae restricted to Indian boundaries. All the specimens of the taxa enumerated below are deposited in Herb., Cal. Nomenclature has been brought uptodate using basinonyms and synonyms as far as possible.

An Enumeration of Indian *Myrtaceae*

A Check-List

Callistemon lanceolatus DC.

Syn. *C. linearis* DC.

Decaspermum fruticosum J.R. & G. Forst.

Eucalyptus camaldulensis Dehnh.

E. citriodora Hook.

E. globulus Labill.

E. paniculata Sm.

E. rudis Endl.

E. teretecornis Sm.

Eugenia arborensis Dunn.

E. (Jambosa) anisopetala Parker

E. argentea Bedd.

E. bifaria Wall.

E. calcadensis Bedd.

E. codyensis Munro ex Wt.

E. diospyrifolia Wall. ex Duthie

E. discifera Gamble

E. floccosa Bedd.

* Reprinted editions.

E. formosa Wall.

E. glaucissima Haines

E. grata Wt.

E. jossinia (Wt.) Duthie

Syn. *Jossinia indica* Wt.

E. khasiana Duthie

E. kurzii Duthie ex Kurz

E. macrosarpa Roxb.

E. macrosepala Duthie

E. mangifolia Wall.

E. michelii Lamk.

E. mooniana Wt.

E. praetermissa Gage

E. ramosissima Wall. ex Duthie

E. revoluta Wt.

E. rottleriana W. & A.

E. singampattiana Bedd.

E. smaliana Brandis

E. tenuis Duthie

E. toddaliodes Wt.

E. uniflora Linn.

E. utilis Talbot.

E. venusta Roxb.

E. wallichi Wt.

Jambosa beddomei (Duthie) Gamble

Syn. *Eugenia beddomei* Duthie

J. bourdillonii Gamble

J. courtallensis Gamble

J. mundagam (Bourd.) Gamble

J. munronii Walp.

Syn. *Eugenia munronii* Wt.

J. occidentalis (Bourd.) Gamble

J. rama-varma (Bourd.) Gamble

Melaleuca leucadendron Linn.

Meteoromyrtus wynaadensis (Bedd.) Gamble

Syn. *Eugenia wynaadensis* Bedd.

Myrtus communis Linn.

Pimenta officinalis Lindl.

Psidium cattleianum Sabine

P. guajava Linn.

Rhodamreja dumetorum (Poir.) Merr. & Perry

Syn. *Myrtus dometorum*

Syn. *Rhodamnia trinerva* Blume

Rhodomyrtus tomentosa (Ait.) Hassk.

Syn. *Myrtus tomentosa* Ait.

Syzygium abortivum (Gagnep.) Merr. et Perry

Syn. *Eugenia abortiva* Gagnep.

S. alternifolium Walp.

Syn. *Eugenia alternifolia* Wt.

S. aromaticum (Linn.) Merr. et Perry

Syn. *Caryophyllus aromaticus* Linn.

S assamicum (Biswas & Purakaystha) Raizada

Syn. *Eugenia assamica* Biswas & Purakayastha

S. aqueum (Burm. f.) Alston

Syn. *Eugenia aquea* Burm. f.

S. balsameum (Wt.) Wall. ex A.M. & J.M. Cowan

Syn. *Eugenia balsamea* Wt.

S. benthamianum (Wt. ex Duthi) Gamble

Syn. *Eugenia benthamiana* Wt. ex Duthie

S. bracteathum (Willd.) Raizada

Syn. *Myrtus bracteata* Willd

S. calophyllifolium (Wt.) Walp.

Syn. *Eugenia calophyllifolia* Wt.

S. caryophyllata (L.) Alston

Syn. *Myrtus caryophyllata* Linn.

Syn. *Eugenia caryophyllaea* Wt.

Syn. *Eugenia corymboia* Lamk.

S. cerasoides Raizada

S. chavaran (Bourd.) Gamble

S. claviflorum (Roxb.) Wall. ex A.M. et J.M. Cowan

Syn. *Eugenia claviflora* Roxb.

S. cinereum (Wall.) Kurz

Syn. *Eugenia cinerea* Wall.

Syn. *Bugenia brachiata* Duthie

S. cumini (L.) Skeels

Syn. *Eugenia jambolana* Lamk.

S. fastigiatum (Bl.) Merr. et Perry

Syn. *Calyptranthus fastigiata* Bl.

S. fergusoni Gamble

S. cyanophyllum (P.C. Kanj. et Das) Raizada

Syn. *Eugenia cyanophylla* P.C. Kanjilal et Das

S fruticosum (Roxb.) DC.

Syn. *Eugenia fruticosa* Roxb.

S. gardneri (Thwaites) Gamble

Syn. *Eugenia gardneri* Thwaites

S. grande (Wt.) Walp.

Syn. *Eugenia grandis* Wight

S. griffithii (Duthie) Merr. et Perry

Syn *Eugenia griffithii* Duthie

S. hemisphericum (Walp) Alston

Syn. *Jambosa hemispherica* Walp.

S. heyneanum (Wall. ex Hook f.) Merr. et Perry

Syn. *Eugenia heyneana* Wall. ex Hook. f.

S. inophyllum (Roxb) D.C.

Syn. *Eugenia inophylla* Roxb.

S. jambos (L.) Alston

Syn. *Eugenia jambos* Linn.

S. kanarense (Talbot) Raizada

Syn. *Eugenia kanarensis* Talbot

S. laetum (Ham.) Gandhi

Syn. *Eugenia laeta* Ham.

S. leptanthum (Wt.) Niedenzu

Syn. *Eugenia leptantha* Wt.

S. lineare (Wall. ex Duthie) Gamble

Syn. *Eugenia linearis* Wall ex Duthie

S. lineatum (DC.) Merr. et Perry

Syn. *Jambosa lineata* DC.

S. malaccense (Linn.) Merr. et Perry

Syn. *Eugenia malaccensis* Linn.

S. malbaricum (Bedd.) Gamble

Syn. *Eugenia malbarica* Bedd.

S. microphyllum (Bedd.) Gamble

Syn. *Eugenia microphylla* Bedd.

S. mishmiense Chatterjee

S. montanum (Wt.) Gamble

Syn. *Eugenia montana,* Wt.

S. myhandrae (Bedd. ex Brandis) Gamble

Syn. *Eugenia myhendrae* Bedd. ex Brandis

S. myrtifolium (Roxb.) DC.

Syn. *Eugenia myrtifolia* Roxb.

S. oblatum (Roxb.) Wall. ex A.M. et J.M. Cown

Syn. *Eugenia oblata* Roxb.

S. occidentala (Bourd.) Gandhi

Syn. *Eugenia occidentalis* Bourd.

S. olivifolium Gamble

S. occlusum (Miq.) Duthie

Syn. *Eugenia occlusa* Miq.

S. operculatum (Roxb.) Neidenzu

Syn. *Eugenia opereculata* Roxb.

S. pachyphyllum (Kurz) Merr. et Perry

Syn. *Eugenia pachyphylla* Kurz

S. palembanicum Miq.

S. palghtensis Gamble

S. phillyraeoides (Trim.) Santapau

Syn. *Eugenia phillyraeoides* Trim.

S. polyanthum (Wt.) Walp.

Syn *Eugenia polyantha* Wt.

S. polypetalum (Wt.) Merr. et Perry

Syn. *Eugenia polypetala* Wt.

S pseudo-laetum (C.E.C. Fischer) Merr. et Perry

Syn. *Eugenia pseudolaeta* C E.C. Fischer

S. rahmpiphyllum (Craib) C.E.C. Fischer

Syn. *Eugenia rhampiphylla* Craib

S. roxburghianum Raizada

Syn. *Eugenia lancaefolia* Roxb.

S. rubicundum (Wt.) W. & A.

Syn. *Eugenia rubicunds* Wt.

Syn. *E. lissophylla* Th waites

S. samarangense (Bl.) Merr. et Perry

Syn. *Myrtus samarangensis* BL.

Syn. *Eugenia javanica* Lamk.

S. stocksii (Duthie) Gamble

Syn. *Eugenia stocksii* Duthie

S. syzygioides (Miq.) Merr. et Perry

Syn. *Jambosa syzygioides* Miq.

S. tetragonum (Wall. ex Wt.) Merr. et Perry

Syn. *Eugenia tetragona* Wall. ex Wt.

S. thumra (Roxb.) Merr. et Perry

Syn. *Eugenia thumra* Raxb.

S. travancorium Gamble

S. wightianum (Wall. ex Wt.) Gamble

Syn. *Eugenia wightiana* Wt.

Syn. *E. lanceolata* Lamk.

S. zeylanicum (Linn.) DC.

Syn. *Myrtus zeylanica* Linn:

S. zimmermanii (Warb. et Craib) Merr. et Perry

Syn. *Eugenia zimmermanii* Warb et Craib

Syn. *Tristania merguensis* Griff.

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STUDIES ON ESSENTIAL OIL CONTENT OF *EUCALYPTUS* SPECIES GROWN IN TARAI REGION OF UTTAR PRADESH, NAINITAL FOR TIMBER

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Introduction

The genus *Eucalyptus,* a native of Australia, is a well known plant (Chopra *et al.* 1956; CSIR, 1952). It belongs to family myrtaceae having more than 700 species and subspecies in the world. Due to its fast growth and manifold uses like railway sleeper, paper-pulp and firewood, a large number of species have been introduced in India by Forest Department. *Eucalyptus* plantations in Tarai and Bhabar region of Uttar Pradesh have also been introduced to meet the demand of wood-based industries in the country. But limited efforts have been made to study the essential oil, a subsidiary product of this plant having much medicinal and perfumery value (CSIR, 1952). 1; 8-Cineol which is the main constituent of the oil from most of the *Eucalyptus* species, has also very good export potential. At current price of oil, cineol costs over US $ 8.00 per kg as against the international price of US $ 4.50 per kg (Communication, 1981).

Material and method

Keeping the above facts in a view, a study on the essential oils was conducted taking different *Eucalyptus* species grown around Lalkuan Forest Nursery which is situated in Tarai region at a latitude 28° 22′ N and longitude 79° 56′ E at an elevation of 256 m above MSL. Average annual rainfall received was 1480 mm of bulk (1317 mm) received during June to September. The mean maximum and minimum temperature was 38.8°C and 7.1°C respectively. The soil was clayey-loam having bouldery sub-soil stratum. The water table was 3.0 to 7.5 m below the ground level. Heavy dew occurred during nights of cold weather during December to February.

Seeds were sown in wooden boxes filled with sand upto 15 cm depth in October just below the surface. Soil was moistened as and when needed. The seeds started germinating after seventh day of sowing and completed within 21 days. The seedlings after attaining 60 cm height were removed from the boxes and transplanted in well prepared nursery beds in March. The seedlings were again removed from nursery beds and transplanted into experimental area in July. Growth character was recorded during October-November, 1980 at different plant-age. Diameter of the plants was measured at 1.37 m (breast height) from ground

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Sl. No	*Eucalyptus* species	Year of planting	Mean height (in meter)	Diameter (cm) Min./max.	Oil content
1.	*E. camaldulensis*	1963	19.70	18.0/18.2	1.71
2.	*E. rudis*	1963	23.40	23.2/25.4	1.38
3.	*E. populifolia*	1963	18.00	25.2/25.8	0 25
4.	*E. hemiphloia*	1963	16.00	17.6/19.2	0.15
5.	*E. crebra*	1963	18.00	13.6/14.0	0.89
6.	*E. robusta*	1963	12.10	14.2/15.6	0.58
7.	*E. alba*	1963	16.10	15.2/15.4	0.09
8.	*E. hybrid*	1963	18.60	19.5/31.5	0.79
9.	*E. citriodora*	1963	29.00	25.0/28.0	0.83
10.	*E. melanophloia*	1963	11.80	17.6/17.8	2.03
11.	*E. tereticornis*	1967	14.40	11.2/11.8	1.80
12.	*E. tereticornis* × *E. camaldulensis*	1967	26.10	28.4/28.8	1.29
13.	*E. delupta*	1967	19.50	26.4/26.4	0.43
14.	*E. camaldulensis* (Australian)	1967	19.30	17.8/18.4	0.11
15.	*E. saligna*	1967	21.00	23.0/24.2	1.76
16.	*E. toroliana*	1967	8.50	10.0/10.4	Traces
17.	*E. tereticornis* × *E. alba*	1967	14.80	13.0/13.0	0.65

Sp. gr. 30°	30° nD	30° α D	Cineol content (%)	Principal constituents
0.9990	1.4592	+15.60°	60.38	Cineol
0.9790	1.4550	+33.80°	54.63	Cineol, α - pinene
0.9840	1.4745	+ 6.40°	70.57	Cineol, terpenes, aldehydes.
0.9820	1.4755	—61.10°	53.95	Cineol, terpenes
0.9820	1.4621	—28.50°	40.55	1 - α - phellandrene, cineol, α - pinene sesquiterpenes.
0.9780	1.4725	+15.60°	32.15	Cineol, α - pinene
0.9830	1.4790	+38.80°	4.86	—
0.9030	1.4680	—	20.85	Cineol, terpenes
0.9840	1.4590	—	—	Citronellal, Citronellol. esters.
0.9530	1.4582	—38.70°	78.34	Cineol
0.9870	1.4620	+37.07°	26.39	Cineol, α - pinene, aldehydes.
0.9820	1.4830	+14.50°	35.14	Cineol
0.9780	1.4725	+15.60°	32.15	Cineol
0.9830	1.4850	+18.97°	20.65	Cineol
0.9830	1.4590	+12.40°	Traces	d-α-pinene, esters, alcohols.
—	—	—	3.23	—
0.9850	1.4792	+46.20°	23.87	Cineol, terpenes, aldehydes.

level with the help of research calliperse and plant height was recorded from the base of plants by Abney's level. The leaves of different *Eucalyptus* species were collected in the month of February and were hydrodistilled in a Clevenger's apparatus for estimation of oil content and subjected to evaluation of their physico-chemical properties. Oils thus obtained were taken in ether and dried over anhydrous sodium sulphate and finally filtered. The solvent was evaporated under reduced pressure. Physico-chemical properties of each of the oil sample was studied as per IS : 326-1968 (Communication, 1969), and presented in the Table. The percentage of cineol was further confirmed by GLC.

Results and Discussion

In general, maximum growth rate was observed during monsoon season (July-September) and lowest during winter season (October-February). For the purposes of comparison, the *Eucalyptus* species may be grouped into three categories, (a) timber value, (b) oil value and (c) timber and oil value.

(a) *Timber value.* *E. citriodora* which had slower growth rate in the begining attained maximum height followed by *E. tereticornis* × *E. camaldulensis*, *E. rudis*, *E. saligna* and *E. camaldulensis*. The girth of *E. tereticornis* × *E. camaldulensis* was found to be maximum followed by *E. delupta*, *E. citriodora*, *E. rudis*, *E. populifolia* and *E. saligna*. Taking both, height and girth of the plant, into account it may be inferred that *E. tereticornis* × *E. camaldulensis* is the best species as per the data in the table since it was planted four years later than *E. citriodora*.

(b) *Oil value.* Maximum oil yield was observed in *E. melanopholia* (2.03%) followed by *E. tereticornis* (1.80%), *E. saligna* (1.76%), *E. camaldulensis* (1.71%), *E. rudis* (1.38%) and *E. tereticornis* × *E. camaldulensis* (1.29%). The cineol percentage in the above species varied from 27-60% except in *E. melanophloia* in which it was maximum (78.34%). Oil content in *E. citriodora* though lowest among other species (0 83%) possesed better value in perfume.

(c) *Timber and oil value.* *E. melanophloia* contained best oil content but poor growth characters. On the contrary, *E. terticornis* × *E. camaldulensis*, *E. populifolia*, *E. saligna*, *E. camaldulensis* and *E. rudis* had higher girth and height over *E. melanophloia* but with lesser oil content. *E. citriodora* had better growth but low oil content. However, the oil obtained from this species is in great demand in perfumery industry. Moreover, collection of leaves from the plants after attaining an age of 4 years will not effect the growth of the plant for timber, actually the lopping of small branches will increase the height and girth of the plant.

Conclusion

From the above studies it may be concluded that cineol, which has its own importance in the pharmaceutical preparations as stimulating expectorant in chronic bronchitis, anaesthetic and antiseptic, in the treatment in inflammatory conditions, in room spray lotions and many cosmetic preparations (Guenther, 1949) may be isolated as a subsidiary product. Keeping in view the timber and the oil value as well, *E. tereticornis* × *E. camaldulensis* is useful for

plantation in the forest followed by *E. saligna, E. camaldulensis, E. populifolia* and *E. rudis*. However, the plantation of *E, melanophloia* may be done only for its oil value in which cineol content is maximum (78.34%) but because of its poor timber value it may not prove fruitful planting in the forest. *E. citriodora* having promising timber value as well as oil of special nature containing citronellol, citronellol and esters may also be useful for plantation on large scale.

The distillation of essential oil from the leaves may be carried out in the areas of plantations by establishing field distillation units. The size and locations, of course, may be kept in view according to the availability of raw material i.e. leaves. The distillation units may run by plants of zero values as well as the bushes and dried leaves which are available in plenty in the forests.

Acknowledgements

The authors are thankful to Dr. Akhtar Husain, Director, Central Institute of Medicinal & Aromatic Plants, Lucknow for his keen interest in this work.

SUMMARY

Seventeen *Eucalyptus* species grown basically for timber in Tarai region of Uttar Pradesh, were studied for its oil as well as timber value. Growth parameters and oil content differred due to species. Among all, *E. tereticornis* × *E. camaldulensis* appeared to be the best species for the purposes of timber as well as oil containing cineol used in medicines. *E saligna, E. camaldulensis, E. populifolia* and *E. rudis* also performed better are the useful species for plantation. *E. citriodora* containing different constituent in the oil may also be a good source of citronellal and citronellol which are used in perfumery industry together with its timber value.

उत्तर प्रदेश के तराई क्षेत्र, नैनीताल में प्रकाष्ठ के लिए उगाई हुई युकेलिप्टस जातियों में
उत्पत तेल की मात्रा सम्बन्धी अध्ययन

लेखक ए०के० सिंह, ए०के० भट्टाचार्य, कमला सिंह, आर०के० दुबे व आर०सी० खोलिया

सारांश

युकेलिप्टस की सत्रह जातियों का, जिन्हें उत्तर प्रदेश के तराई क्षेत्र में मूलत: प्रकाष्ठ के लिए उगाया जा रहा है, प्रकाष्ठ मूल्य और उनके तेल के लिए अध्ययन किया गया। जातियों के कारण वृद्धि परिमाप और तेल तत्व में अन्तर रहा। इन सब में से प्रकाष्ठ और तेल दोनों प्रयोजनों के लिए यु० टेरेटिकार्निस, यु० कैमेलड्युलेंसिस सर्वोत्तम प्रतीत हुई जिसके तेल में औषधियों में काम आने वाला सिनियोल होता है। यु० सैलिग्ना, यु० कैमेलड्युलेंसिस, यु० पाप्लिफौलिया और यु० रूडिस की वृद्धि अच्छी रही और ये रोपवन लगाने के लिए उपयोगी जातियां हैं। प्रकाष्ठ मूल्य होने के अतिरिक्त यु० साइट्रियोडोरा के तेल में कई संयोगांग होते हैं तथा यह साइट्रियोनीलेल और साइट्रियोनीलाल का अच्छा स्रोत है जिनका उपयोग सुगन्ध निर्माण उद्योग में किया जाता है।

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A PRELIMINARY NOTE ON COMPRESSION LOSS IN PLYWOOD

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Introduction

Plywood is now a well established industry in India, but we are not able to compete in the world market. One of the reasons for this may be said to be uneconomical processing which may not be due to the fault of anybody, but may be due to the requisite data for the purpose of more efficient working being not available. The importance of the necessary data is all the more important because in our country, unlike western countries, the number of species used for plywood is more than eighty. For the production of plywood of a particular thickness in the absence of detailed data regarding compression, the thickness of the veneer used for the manufacture is appriciably more than what is required and as such more timber is consumed for making the plywood than what is actually necessary. In addition to this, higher thickness of the plywood requires subsequent sanding to bring it to the required thickness. As a result of these two reasons the cost of plywood is naturally increased which contributes partially to our inability to compete in the world market. In foreign countries data is available for their species by which they are able to peel the veneers of just the sufficient thickness by which they may be able to get the plywood of a particular thickness. In India not much published data is available in this respect. In view of the above, it was considered adviseable to take up the study of compression loss in the production of plywood of various grades and types.

Experimental

For the preliminary study logs of *Mangifera indica* (Dehra Dun) and *Terminalia myriocarpa* (Assam) were peeled into veneers of 1.6 mm thickness used for making plywood of different types i.e., 3-ply, 5-ply, 7-ply and 9-ply.

Veneers of 30 cm × 30 cm size were clipped for making plywood from both the species. Before gluing the veneers for making a board, they were first assembled in a true from of a board i.e.; the grains of alternate veneers running at right angles to the other Thicknees of each veneer was now measured with a dial gauge at four points in the middle of each side, and the total sum of thickness of the veneers of a board on those points was taken as initial thickness of the board before pressing. The veneers of a board were then glued and assembled in the same sequence as arranged before. The boards were then subjected to pressure under stabilized heating conditions of 100°C of the press. Two boards for each type of

Table

Test Results of Percentage Campression Loss

Adhesive used - Urea formaldehyde

Sl. No.	Pressure used for pressing plywood (kg/cm²)	3 – PLY Density of plywood	Moist. content % of plywood	Thickness before painting (mm)	% Compression loss	5 – PLY Density of plywood	Moist. content % of plywood	Thickness before painting (mm)
1	2	3	4	5	6	7	8	9
						Species : *Mangifera indica*		
1.	7.0	0.599	9.7	5.03	3.25	0.571	8.6	8.47
2.	10.5	0.612	9.2	4.98	4.52	0.554	9.2	8.50
3.	14.0	0.643	10.1	4.98	5.82	0.604	1.9	8.60
4.	17.5	0.631	9.5	5.06	6.34	0.629	9.1	8.39
5.	21.0	0.630	9.5	5.96	7.26	0 620	8.7	8.31
6.	28.0	0.672	9.1	4.96	10.59	0.669	8.4	8.13
						Species : *Terminalia myriocarpa*		
1.	7.0	0.669	9.6	5.15	4.52	0.668	10.1	8.51
2.	10.5	0.689	9.6	4.94	5.77	0.671	10.6	8.50
3.	14.0	0.692	10.3	5.14	5.95	0.696	10.7	8.36
4.	17.5	0.725	10.0	5.07	7.07	0.722	9.7	7.66
5.	21.0	0.737	9.6	5.15	7.60	0.727	10.4	7.42
6.	28.0	0.747	9.5	5.07	10.08	0.743	10.5	8.03

1

in Plywood at *Different Pressures*

Temperature - 100°C

	7 - PLY				9 - PLY			
% Compression loss	Density of plywood	Moist. content % of plywood	Thickness before painting (mm)	% Compression loss	Density of plywood	Moist. content % of plywood	Thickness before painting (mm)	% Compression loss
10	11	12	13	14	15	16	17	18
2.62	0.590	9.4	11.48	2.04	0.575	8.9	14.67	1.27
3.39	0.586	9.3	11.47	2.68	0.571	8.8	14.67	2.30
3.94	0.609	9.0	11.41	3.19	0.573	8.5	14.46	2.92
5.29	0.604	9.2	11.61	3.68	0.580	9.2	14.80	3.22
6.92	0.603	8.9	11.40	5.52	0.578	8.9	14.68	5.22
9.88	0.624	9.0	11.44	7.47	0.607	9.5	14.96	6.66
4.26	0.656	10.6	11.81	4.18	0.656	11.9	15.01	3.95
5.40	0.707	10.5	11.33	5.25	0.657	11.7	15.44	4.90
5.79	0.716	10.4	11.34	5.61	0.663	11.8	15.45	5.48
6.86	0.717	10.9	12.32	6.44	0.666	11.0	14.97	6.34
7.43	0.718	10.7	11.76	7.25	0.690	11.7	15.12	7.13
9.52	0.721	10.8	12.00	9.35	0.717	11.6	15.46	9.26

plywood in one charge were prepared at different pressing conditions for each thickness. The time period for pressing was different for each type of plywood i.e. 10′ for 3-ply, 13′ for 5-ply, 16′ for 7-ply and 19′ for 9-ply. After taking the boards from the press they were left for conditioning at room temperature for about a week and the measurements were again taken for thickness of the boards on the same four points in the middle of each side with a dial gauge.

The deformation due to compression at four points in the middle of each side of a board was calculated in each case and thus the average percentage deformation called as percentage compression loss for a board was obtained. In each type average of two boards was taken.

The conditions used for preparing plywood of different thicknesses with different pressures are given below. Moisture content of veneers of both the species used for making plywood was approximately 8 per cent.

Adhesive used	—	Urea formaldehyde
Pressure	—	7.0 kg/cm², 10.5 kg/cm², 14.0 kg/cm², 17.5 kg/cm², 21.0 kg/cm² & 28.0 kg/c n².
Temperature	—	100°C
Time	—	10′, 13′, 16′, 19′
Kind of plywood prepared	—	3-ply, 5-ply, 7-ply, 9-ply
Size of plywood	—	30 cm × 30 cm.

The results of compression loss at different pressures of plywood are given in Table 1.

Results and Discussions

The compression loss is dependent on many factors viz., species, thickness of the veneers, pressure during pressing, temperature of pressing, moisture content of the boards and duration of pressing. So it is quite a comprehesive problem. However, with the limited study carried out it can be seen from Table 1 that the percentage compression loss in plywood of the same thickness increases with the increase in pressure but decreases with the increase in the thickness of the plywood for the same pressure in both the species, although the percentage compression loss is different for the two species.

The reason for the decrease in compression loss with increased layers and thickness may be due to the fact that the surface layers act as a cushioning material and do not transmit pressure fully to inside which is applied to the pack, resulting in lower percentage compression ultimately on thickness basis. It is also likely that the temperature in the inner layers did not reach the required value, so that plasticisation due to the increased temperature was less in the inside and so the compression was lower. However, it may be useful to have the data for the actual process of pressing followed in the industry, which would help in calculating the actual thickness of veneers required for a particular thickness of plywood.

SUMMARY

It is natural that plywood gets compressed under certain pressing conditions, but the data regarding Indian species of wood is not available. The present note evaluates the Compression loss in plywood made from *Mangifera indica* and *Terminalia myriocarpa* for a few pressing conditions and thickness of plywood. This knowledge may be useful to the industry to evaluate the final thickness of plywood produced by them from veneers.

स्तरकाष्ठ की संपीडन हानि के सम्बन्ध में प्रारम्भिक टिप्पणी

लेखक आर०सी० गुप्त व आर०एस० शाह

सारांश

स्वाभाविक ही है कि स्तरकाष्ठ दबाव देने पर संपीडित हो जाता है, परन्तु भारतीय काष्ठ जातियों के विषय में इसके आँकड़े उपलब्ध नहीं हैं। प्रस्तुत टिप्पणी में मैंगीफेरा इण्डिका (आम) और टर्मिनेलिया माइरियोकार्पा से कई तरह के दबावों पर और कई मोटाइयों में बनाए गए स्तरकाष्ठ में हुई संपीडन हानि का मूल्यांकन किया गया है। यह अध्ययन इस उद्योग के लिए परतों से बनाए गए स्तरकाष्ठ की अन्तिम मोटाई का निर्धारण करने के लिए उपयोगी हो सकता है।

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KRAFT PULPING OF *ACACIA ROBUSTA* AND *ACACIA MELLIFERA*

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Introduction

Acacia, a large genus comprising of over 500 species, is found in warm and dry parts of the World. It belongs to natural order *leguminosea*. In India, about 22 indigenous species are distributed throughout the plains and they yield three major products tannin, gum and timber.

Due to increasing shortage of conventional fibrous raw materials for the paper industry, various species of naturally occuring and plantation grown hardwoods are being continuously evaluated for their suitability as a source of cellulose fibres for paper in this Laboratory. Results on *Acacia nelotica* (Guha and Sharma, 1976) has been published and this paper deals with the results on *Acacia robusta* and *Acacia mellifera*.

Raw material

Wood of each species was collected from Botanical garden of Forest Research Laboratory, Coimbatore. The age of *Acacia robusta* and *Acacia mellifera* was 9 and 4 years respectively at the time of collection.

Experimental

The debarked logs were chipped and screened to a chip size of about 2.5×1 × 0.5 cm, collected and stored in polythene bags for pulping experiments.

Proximate Chemical Analysis. Wood meal passing through 60 mesh and retained on 80 mesh was prepared and used for proximate chemical analysis. Tappi standard methods were used for the analysis. The results are recorded in Table 1.

Table 1

Proximate Chemical Analysis

Sl. No.	Particulars	*Acacia robusta*	*Acacia mellifera*
1.	Cold water solubility %	9.24	6.1
2.	Hot water solubility %	14.1	9.24
3.	1% NaOH solubility %	20.1	13.3
4.	Alcohol-Benzene solubility %	8.8	14.4
5.	Klason Lignin %	21.8	20.4
6.	Holocellulose %	70.3	69.6

N.B.—All are based on o.d. wood dust.

Fibre Dimensions. Average values of length, diameter and wall thickness of the fibre determined as usual by taking average of 100 measurements are recorded in Table 2.

Table 2

Fibre Dimensions

Sl. No.	Particulars	*Acacia robusta*	*Acacia mellifera*
1.	Fibre length	1.3 mm	1.07 mm
2.	Fibre diameter	18.3 μm	15.95 μm
3.	Wall thickness	7.15 μm	4.5 μm
4.	Lumen diameter	4. 0 μm	5.69 μm
5.	Slenderness ratio L/d	71.03	66.95
6.	Runkel ratio 2w/d, %	8.14	56.42

Pulping. Chips (400 gms o.d.) of *Acacia robusta* and *Acacia mellifera* were cooked with kraft process in an electrically heated rotary digester. After cooking, the cooked chips were washed with hot water on a terylene cloth, disintegrated and screened on lamberts laboratory screen using a plate with 9.35 mm flat cut size slots. The screened pulps were also collected in terylene cloth. Pulping conditions, screened pulp yields and screen rejects were determined as usual. The kappa number was determined using Tappi standard. The results are recorded in Table 3.

Table 3

Pulping Studies

Sl. No.	Particulars	*Acacia robusta*	*Acacia mellifera*
1.	Active alkali as Na_2O %	16	16
2.	Sulphidity %	25	25
3.	Time, schedule (in minutes)		
	(a) Room temp. to 100°C	30	30
	(b) 100°C to 170°C	105	105
	(c) At 170°C	90	90
4.	Screened pulp yield %	52.23	51.16
5.	Screened rejects %	0.47	0 26
6.	Kappa number	26.4	23.4

N.B.—Percentages are based on o.d. wood chips.

Bleaching. Unbleached pulps of both the species obtained as above, were taken for bleaching studies for the production of bleached grade pulps. The bleaching conditions, bleached pulp yield and brightness (Elrepho) were determined as usual and are recorded in Table 4.

Table 4
Bleaching Studies

Sl. No.	Particulars	*Acacia robusta*	*Acacia mellifera*
1.	Kappa number	26.4	23.4
2.	*Chlorination stage*		
	Available chlorine, % applied on O.D. pulp	5	5
	Consistency, %	4	4
	Temperature in °C	28	28
	Time in minutes	30	30
3.	*Alkali Extraction*		
	Alkali dose given as NaOH	2	2
	Consistency, %	5	5
	Temperature in °C	70	70
	Time in minutes	60	60
4.	*Hypo stage–I*		
	Available chlorine, % applied on O.D. Pulp	3	3
	Consistency, %	4	4
	Temperature in °C	40	40
	Time in minutes	120	120
	pH during bleaching	10–11	10–11
5.	*Hypo stage–II*		
	Chlorine available, % applied on O.D. pulp	0.5	0.5
	Consistency, %	4	4
	Temperature in °C	40	40
	Time in minutes	120	120
	pH during bleaching	10–11	10–11
6.	Bleached pulp yield*, %	94.85	95.15
7.	Brightness (mgo = 100)	70.62	68.0

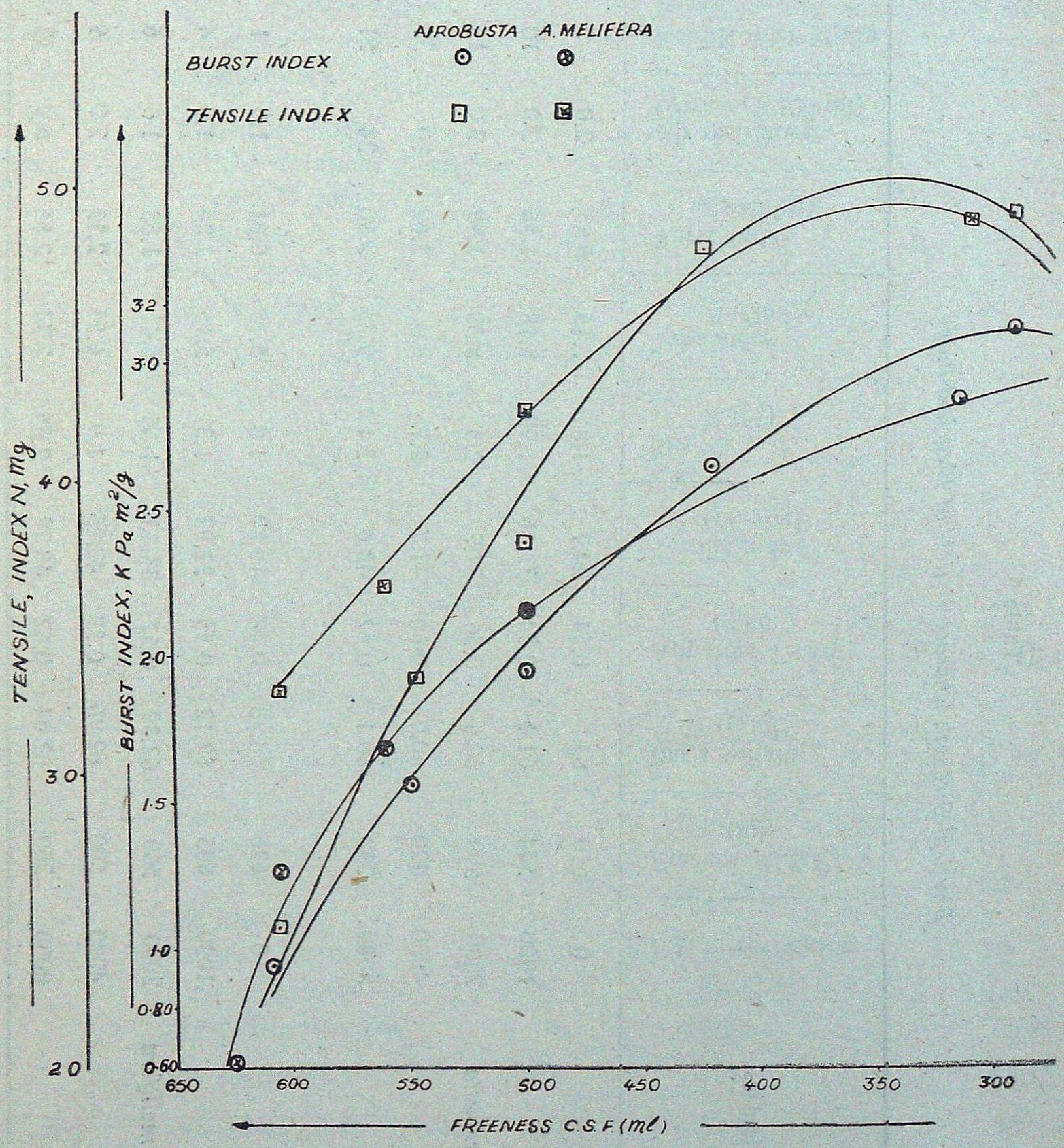
Bleached pulps thus obtained were beaten in P.F.I. mill at different revolutions. Standard sheets of 60 gsm were made from beaten pulps as per standard procedure and tested for physical strength properties at 27 ± 1°C and 65% RH. Results are recorded in Table 5. Some of the properties interpolated at freeness 400 C.S.F. (ml) from graphical representation (Fig. 1 & 2) are given in Table 6.

Table 5

Physical Strength Characteristics of Bleached Pulps

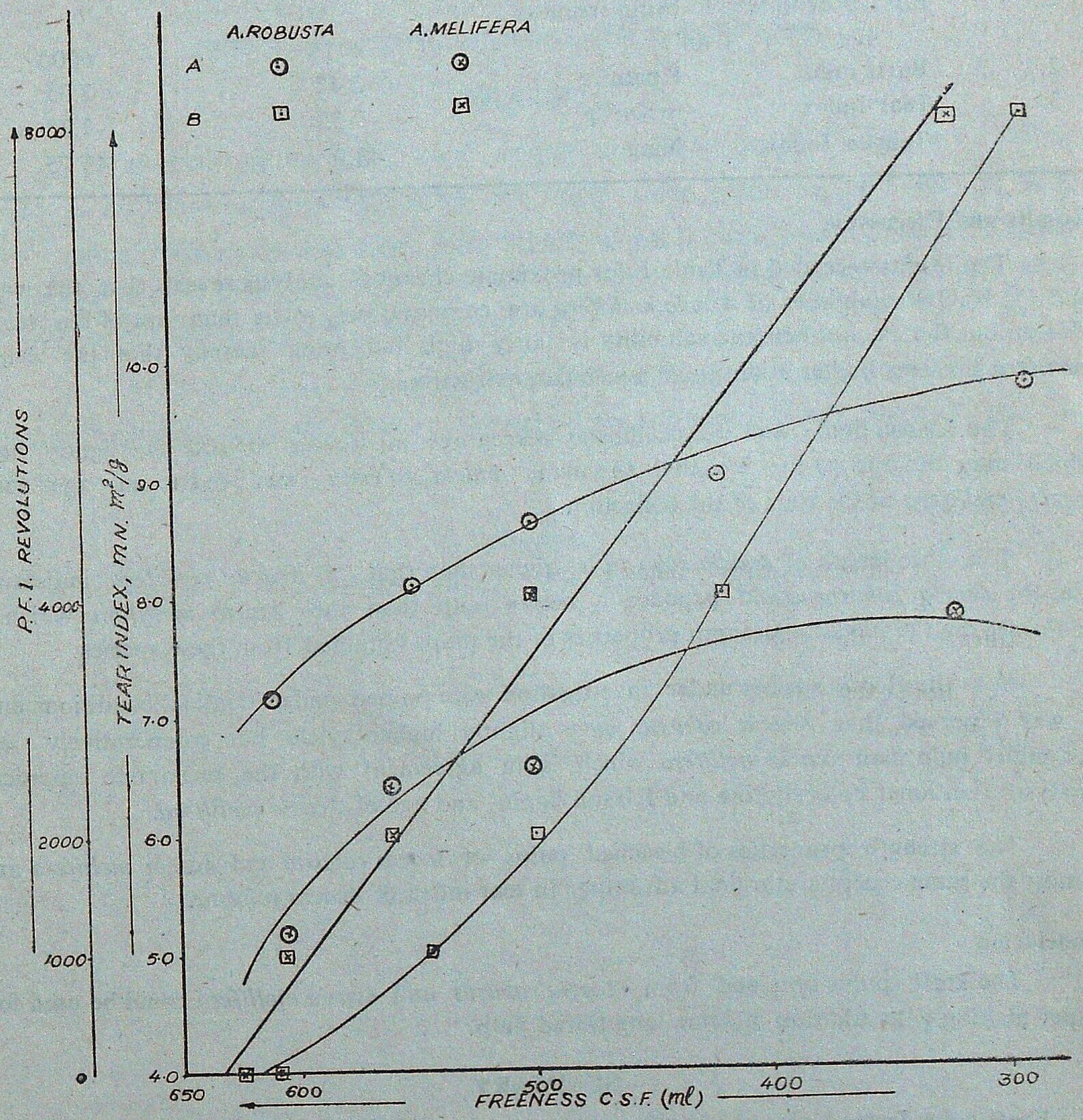
Sl. No.	Particulars	P.F.I. revolution	Freeness, C.S.F. (ml)	Basis weight (g/m²)	Apparent Density (g/cm³)	Tensile index (N. mg)	Stretch (%)	Tear index (mNm²/g)	Burst index (Kpam²/g)	Air resistance Gurley (S/100 ml)	Fold Kohler Molin	Breaking length (km)
		0	610	63.5	0.54	24.7	1.8	7.15	0.93	2.0	5	2.52
		1000	544	61.1	0.54	33.16	1.99	8.18	1.56	2.0	10	3.38
1.	*Acacia robusta*	2000	500	60.6	0.56	37.7	2.3	8.58	1.99	3.0	15	3.84
		4000	420	60.0	0.60	47.7	2.7	9.0	2.62	80	31	4.86
		8000	290	60.1	0.62	48.9	3.1	9.75	3.90	24	51	4.99
		0	625	64.73	0.48	19.89	1.0	5.15	0.61	1.0	1	—
		1000	605	62.12	0.55	32.93	1.3	5.15	1.26	1.0	4	3.36
2.	*Acacia mellifera*	2000	560	62.39	0.57	36.33	1.65	6.41	1.68	1.0	6	3.71
		4000	500	62.96	0.59	42.25	1.9	6.54	2.13	2.0	9	4.31
		8000	300	62.04	0.62	48.78	2.55	7.74	2.85	6.0	17	4.97

Fig. 1



Relationship between Burst index and Tensile index v/s freeness C.S.F. (ml)

Fig. 2



Relattonship between Tear index and P.F.I. Revolutions v/s freeness C.S.F. (ml)

Table 6

Physical Strength Properties of Bleached Pulps at 400 C.S.F. (ml) freeness.

Sl. No.	Particulars		*Acacia robusta*	*Acacia mellifera*
1.	P.F.I. Revolution to bring freeness 400 C.S F. (ml)		4775	6000
2.	Burst index	Kpam²/g	2.42	2.35
3.	Tear Index	mNm²/g	9 30	7.35
4.	Tensile Index	Nmg.	48.0	46 75

Results and Discussion

The results recorded in Table 1 for proximate chemical analysis reveal that the water and 1% NaOH solubilities of *Acacia mellifera* are comparatively lower than that of the *Acacia robusta* but the alcohol-benzene solubility is fairly high indicating thereby that the *Acacia mellifera* contains higher quantity of non-polar extractives.

The Klason lignin and Holocellulose percentage in *Acacia robusta* is slightly high which may be due to the fact that the plant *Acacia robusta* was older in age than *Acacia mellifera* at the time of the collection.

The fibre length of *Acacia robusta* is higher than that of *Acacia mellifera* indicating that the *Acacia robusta* could produce a better pulp than the *Acacia mellifera* which is confirmed by the physical strength properties of the pulps obtained from these species.

Both the *Acacia* species under investigation were pulped under identical conditions and it was observed that *Acacia robusta* gave slightly higher yield but comparatively less delignified pulp than *Acacia mellifera* which is in agreement with the proximate chemical analysis (i.e. loner holocellulose and Klason lignin) and age of *Acacia mellifera.*

The strength properties of bleached pulps of *Acacia robusta* and *Acacia mellifera* are almost the same except a marginal advantage in tear index of *Acacia robusta.*

Conclusion

The kraft pulps obtained from *Acacia robusta* and *Acacia mellifera* could be used for paper making with addition of some long fibred pulp.

SUMMARY

Kraft pulps from *Acacia rodusta* (9 year) and *Acacia mellifera* (4 year) were produced with 16% Active alkali at 25% sulphidity with pulp yield of 52.23% and 51.16% respectively. The pulps obtained could be bleached with C/E/H/H sequence to a brightness (Elrepho) of 70.62 and 68.0 respectively, the bleached pulp yield being 49.5% and 48.67%, respectively. The bleached kraft pulps obtained from both the species possessed almost similar physical strength properties.

The investigations indicate that bleached kraft pulps from *Acacia robusta* and *Acacia mellifera* could be used satisfactorily for paper making with the addition of some long fibred pulp.

अकेसिया रोबस्टा और अकेसिया मेल्लिफेरा से क्राफ्ट लुगदी बनाना

लेखक के०एस० भण्डारी, एस०एस० भण्डारी व एस०बी० सिंह

सारांश

25% सल्फाइडता रख कर 16% सक्रिय समाक्षार से अकेसिया रोबस्टा (9 वर्ष) और अकेसिया मेल्लिफेरा (4 वर्ष) की क्राफ्ट लुगदी तैयार की गई और इसकी प्राप्ति क्रमशः 52.23% और 51.16% रही। लुगदी को सी-ई-एच-एच अनुक्रम द्वारा क्रमशः 70.62 व 68.0 चमक (एलरेफो) तक विरंजित किया गया, विरंजित लुगदी की प्राप्ति क्रमशः 49.5% व 48.67% रही। दोनों काष्ठ जातियों से बनी क्राफ्ट लुगदी लगभग एक समान भौतिक शक्ति विशेषताओं वाली रही।

दन अन्वेषणों से पता चलता है कि अकेसिया रोबस्टा और अकेसिया मेल्लिफेरा से बनी विरंजित क्राफ्ट लुगदियां थोड़ी लम्बी रेशे वाली लुगदी मिला कर संतोषजनक ढंग से कागज बनाने के लिए उपयोग में लाई जा सकती हैं।

Reference

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HIGH DENSITY *EUCALYPTUS* PLANTATIONS IN BHAVNAGAR DISTRICT

V.J. PATEL

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Introduction

Gujarat with about 10% of the States geographical area under forest, is a Forest poor state. The per capita forest area works out to 0.06 ha which is lower than the All India average of 0.13 ha and far below the World average of 1.04 ha. The gap between the demand and supply of Forest produce is so wide that even the most intensive management of the existing Forests cannot bridge it. The increasing human population would keep the demand for small timber and fuelwood high even in future. (Social Forestry Project - G.F.D.)

The need of the day is, therefore, to take forestry outside the recognised borders of the reserved forests. Social Forestry a new concept of forest creation in non-traditional areas with complete involvement of people, management and utilisation of goods and services generated there from for the benefit of the society is the only answer. It aims at combining and utilising the land, labour and water resources to the best interests of the society in such a manner that the Community becomes self sufficient in food, farm manure, firewood and small constructional timber etc. (Tiwari, 1956, 1981).

With this objectives, the Extension Forestry Wing of Gujarat initiated raising of plantations along roadside and canal banks in 1970. In second stage, it started raising village wood lots since 1974 in the Community grazing lands which were lying idle without producing even a blade of edible grass to graze. These lands were getting deteriorated year after year due to constant trampling by cattle and soil erosion. The State Forest Department has done marvellous work in both these sectors and at present all these activities are expanded and enlarged under the World Bank aided Community Forestry Project which has come into operation since 1980. (World Bank report of G.F.D.)

The annual requirements of timber and fuelwood in the State are estimated at 8.6 lac m^3 of timber and 60.7 lac tonnes of fuelwood respectively. As against this the State Forests produce 1.3 lac m^3 of timber and 11.6 lac tonnes of fuelwood. The rest is met from import from neighbouring States, agriculture residues and so on. Due to acute shortage of fuelwood specially in the rural areas, it is estimated that about 10.6 lac tonnes of precious cow dung goes to hearth instead of to field as manure. On the other hand, an average farmer of Gujarat has no means to afford use of inorganic fertilizers because of financial constraints. His ownership lands are thus starved of manure resulting into considerable deterioration and reduction in yeilds. This coupled with uncertain and erratic monsoon adds to his miseries. It is, therefore, very essential to make a farmer self-sufficient even surplus in his requirement of small

timber and fuelwood There are more than 25 lac land holders in Gujarat and even if a farmer plants about a couple of hundred trees around his fields he can become self-sufficient in his requirements of small timber and fuelwood. The Govt. of Gujarat, therefore, started supplying seedlings of various tree species free of cost to people 9 and *Eucalyptus* being a versatile fast growing coppicing species useful both as small timber and fuelwood caught imagination of the farmers vary fast as returns were very quick and remunerative without any problem of scarcity of labour, damage by insects, etc. Large number of progressive farmers gave a lead in *Eucalyptus* farming with the help and guidance of forest department. Convinced with the success and quick returns particularly under irrigated conditions even small and tribal farmers have resorted to tree farming in Gujarat and especially the farmers in Bhavnagar district have systematically planned to grow millions of trees such as *Eucalyptus*, Sabaval, Bamboo, etc. It was therefore, necessary to develop a suitable model keeping in view the small and marginal farmers who cannot afford to wait for the long (4-5 years) gestation period involved in tree farming.

Initially *Eucalyptus* trees farming was being undertaken at various spacings of 3 m×1 m, 3 m×1.5 m and 2 m×1 m with the inter cropping of groundnut, cotton, bajri, wheat, onion, fodder, vegetables, etc. In such a mixed farming, *Eucalyptus* assumes secondary place and no special fertilizers or irrigations are provided to *Eucalyptus* trees for their rapid growth during first couple of years. Moreover, agriculture crops can be taken for a year or two only. On account of uncertain and erratic monsoon, costly seeds and fertilizers, their non-availability when needed most, uncertain markets, diseases, etc., the farmers have been heavily loosing in farming of hybrid varieties of agriculture and horticulture crops. If a farmer wents to prosper, he must use all the cow dung produced by his cattle as manure and should have cooking energy resource of his own. This can only be done if he raises fast growing coppicing small timber and fuelwood trees in small areas in or around the boundary of his fields.

Bhavnagar is a semi-arid district in Saurashtra of Gujarat. Grafted varieties of *Zizyphus mauritians* were successfully raised by the author in "Surendrabag Farm" since several years. As the grafts grow old and needed replacement, it was decided to do *Eucalyptus* farming at a closer espacement. First *Eucalyptus* planting was undertaken at espacement of 2.5 m × 1 m in 1977 and was continued with spacing of 2.5 m × 0.60 m in 1978. In 1979, the technique of planting of *Eucalyptus* was changed over to a block planting at uniform spacing of 60 cm × 60 cm with heavy dozes of fertilizers and irrigation. The observations and dxperiences gained on these plantations enabled the author to develop the scheme for *Eucalyptus* tree farming for small farmers which can make them economically self-reliant by adopting "High Density Eucalyptus Plantation".

The significant observations made from the "HDEP" are :

(i) Almost all the plants show a fairly even and uniform growth with hardly any suppression due to root and crown competition.

(ii) Due to close spacing evaporation losses and weeding costs are reduced.

(iii) Bole formation is uniform with gradual taper at the top.

The main objectives of tree farming at closer spacement are :

(i) To make the farmer economically self-sufficient from a small farm area.

(ii) To maximise the production by optimum utilization of land area.

(iii) To grow pole crop for useful construction of rural houses.

(iv) To provide sely employment to members of the family of farmers.

Modalities. If a farmer sets aside only 0.4 ha (1 acre) of his land under H D E P, he can create sustained source of income enabling him to improve his living conditions. *Eucalyptus hybrid* can be planted at an espacement of 60 cm × 60 cm, making the plant population of 25000 per hectare, after criss-cross ploughing and adding 10% B.H.C. powder in each pit before planting. After planting, 50 gm of caster cake and 10 gm of NPK (12 : 32 : 56) should be given to every plant. During weeding should be carried out as and when necessary. Casualties should be replaced with tall plants through-out the year as and when necessary to keep high survival rate. 20 Irrigations, should be given at the interval of 15 days. Soil working should be carried out 5 times a year. One tonne of urea per 0.4 ha, should be applied in 5 split dozes, each doze after 3 irrigations. In the second and subsequent years, the irrigation, application of fertilizer and soil working should be carried out at the same intensity as in the first year.

Financial. The cost of formation of plantation in the first year amounts to Rs. 4590/- and the maintenance cost in the subsequent years amounts to Rs. 2790/- per unit of 0.4 hectare. The breakup of the expenditure is shown in Annexure I. The break up of material and labour cost in the first 4 years has been worked out and the details are given in Annexure II. A farmer who carries out HDEP in 0.4 ha, will be able to attend to all the plantation works through family labour and hence the loan component is restricted only to the material cost in the respective years. However, it may be necessary to provide loan for subsistance, during the gestation period of first 4 years at Rs. 250/- per month, particularly to the small and marginal farmers who are not in a position to spare the land for HDEP without adversely affecting their food requirement. The schedule of repayment of loan and interest has been worked out separately for those who need subsistance allowance and who are not in need subsistance allowance. The details are given in Annexure III.

Returns. A a result of intensive management, at least 90% of the trees will produce poles in the 4th year. However, it is proposed to harvest the crop on sustained yield basis—one third each in the 4th, 5th and 6th year. For calculating the financial returns, very conservative estimate of Rs 10/-, Rs. 12/- and Rs. 14/- per pole has been made in 4th, 5th and 6th year respectively This assumptions are made on the basis of practical experience of HDEP but even assuming that the small farmer would attain 50% efficiency, the returns from the plantations will be Rs. 15,000/- in the 4th year, Rs. 18,000/- in the 5th year and Rs. 21,000/- in the 6th year and so on.

Annexure I

Cost of HDEP of 0.4 ha (1 acre)

Srl. No.	Details of work	Material cost	Labour cost	Total cost
	I—*Cost of formation of plantation :*			
(1)	Preparation of land	100.00		100.00
(2)	Caster cake 50 gm/seedling	350.00	10.00	360.00
(3)	Fertiliser NPK 10 gm/seedling	300.00	10.00	310.00
(4)	B.H.C. 10% 10 kg	25.00	5.00	30.00
(5)	Planting of seedlings	—	1000.00	1000.00
(6)	Layout for irrigation	—	40.00	40.00
(7)	Irrigations 20 per year @ Rs. 30/- per irrigation	600.00	100.00	700.00
(8)	Fertiliser urea 1 ton	1800.00	50.00	1850.00
(9)	Soil working 5 times a year	—	200.00	200.00
	Sub-Total	3175.00	1415.00	4590.00
	II—*Maintenance of 1 year old plantation :*			
(1)	Layout for irrigation	—	40.00	40.00
(2)	Irrigation 20 per year	600.00	100.00	700.00
(3)	Fertiliser-urea 1 ton	1800.00	50.00	1850.00
(4)	Soil working 5 times a year	—	200.00	200.00
	Sub-Total	2400.00	390.00	2790.00
	III—*Maintenance of 2 year old plantation .*			
(1)	Layout for irrigation	—	40.00	40.00
(2)	Irrigation 20 per year	600.00	100.00	700.00
(3)	Fertiliser-urea 1 ton	1800.00	50.00	1850.00
(4)	Sail working 5 times a year	—	200.00	200.00
	Sub-Total	2400.00	390.00	2790.00
	IV—*Maintenance of 3 year old plantation & exploitation of 3000 trees :*			
(1)	Layout for irrigation	—	40.00	40.00
(2)	Irrigation 20 per year	600.00	100.00	700.00
(3)	Fertiliser-urea 1 ton	1800.00	50.00	1850.00
(4)	Soil working 5 times a year	—	200.00	200.00
(5)	Cutting and stacking of 3000 trees	—	1500.00	1500.00
	Sub-Total	2400.00	1890.00	4290.00

The farmer who obtains a loan of Rs. 11,660 in the first 4 years only towards material cost shall be able to clear the loan by 6th year, even after retaining part of the earning in 4th, 5th and 6th year for his subsistance. Similarly the farmer obtaining loan of Rs. 23,580/- including Rs. 10,500/- towards subsistance, shall be able to repay the loan by 7th year. Annexure III indicates the repayment of loan and interest.

The foregoing details substantially prove that the net returns to the farmers from raising 0.4 hectare "High Density *Eucalyptus* Plantations" are significently higher than the expected returns from seasonal agricultural crops and 0.4 hectare HDEP can create a permanent source of income at least for a period of 20 years to a small or marginal farmer.

Annexure II

Cost of Plantation

Year	Material Cost Rs.	Labour Cost Rs.	Total Cost Rs.
1	3175	1415	4590
2	2400	390	2790
3	2400	390	2790
4	2400	1890	4290

It is proposed to provide loan only for material cost as the farmer will be able to put the family labour for plantation works in an area of 0.4 hectare. In addition, it may be necessary to provide loan for subsistance during the gestation period of first 4 years @ Rs. 250-00 P.M. to the small and marginal farmer. The economics of the plantation and the schedule of repayment of loan have been worked out as under :—

Year	Loan	Cummulative loan	Interest payable	Details of loan plantation cost	
I *Farmers not in need of subsistance allowance*					
1	3175.00	3175.00	—		
2	2845.00	6020.00	444.50	Cost	2400 00
				Int	445.00
3	3243.00	9263.00	842.80	Cost	2400.00
				Int	843.00
4	2400.00	11663.82	1296.82	Cost	2400.00
II—*Farmers in need of subsistance allowance*					
1	6175.00	6175.00	—	Cost	3175.00
				Sub-All.	3000.00
2	6265.00	12440.00	864.00	Cost	2400 00
				Sub-All.	3000 00
				Int	865.00
3	7240.00	19680.00	1741.00	Cost	2400 00
				Sub-All.	3000.00
				Int	1740.00
4	3900.00	23580.00	2755.00	Cost	2400.00
				Sub-All.	1500.00

Annexure III

Loan repayment schedule

Year	Gross income from plantation (Rs.)	Expenditure during the (Rs.)	Net income (Rs.)	Amount to be retained by the farmer (Rs.)	Amount to be repaid Loan (Rs.)	Amount to be repaid Interest (Rs.)	Balance loan outstanding (Rs.)
I—*Farmeres not in need of subsistance allowance*							
4	15000.00	—	15000.00	8000.00	5703.00	1297.00	5960.00
5	18000.00	4290.00	13710.00	8000.00	4875.00	835.00	1085.00
6	21000.00	4290.00	16710.00	15473.00	1085·00	152.00	—
II—*Farmers in need of subsistance allowance*							
4	15000.00	—	15000.00	6000.00	6245.00	2755.00	17335.00
5	18000.00	4290.00	13710.00	6000.00	5283.00	2427.00	12052.00
6	21000.00	4290.00	16710.00	6000·00	9022.00	1608.00	3030.00
7	18750.00	4625.00	14125.00	10670 00	3030 00	425.00	—

SUMMARY

Meagre per capita forest area, wide gap between demand and supply position necessitate new approaches to forestry. Traditional forestry practices adopted and advocated wider spacing presuming that with wider spacing, more favourable conditions will be available to plants. This concept needed change in view of development of the technologies in the field of forestry. Moreover even a small farmer has to be self-sufficient in his requirements of small timber and fuelwood. The present paper gives a model of plantation suitable for adoption by small and marginal farmers who cannot wait for longer gestation period in tree farming The advantages of raising high density plantation, the pattern of raising it in 0.4 ha, likely expenditure required, loan required by small and marginal farmers, and repayment schedule of loans by farmers in need or not in need of subsistance allowance has been discussed in this paper.

भावनगर जिले में अधिक सघनता वाले यूकेलिप्टस रोपवन

लेखक वी०जे० पटेल

सारांश

प्रति व्यक्ति कम वन क्षेत्र तथा माँग और प्रदाय के बीच अधिक व्यवधान वानिकी के प्रति नई दृष्टि अपनाना आवश्यक बना देते हैं। पारम्परिक वानिकी प्रणालियों ने वृक्षों के दरम्यान अधिक चौड़ा अन्तराल रखा और उसी को प्रतिपादित किया, संभवतः यह मानकर कि अधिक दूरी रखने से पौधों को बढ़ने की अधिक अनुकूल दशाएँ उपलब्ध होंगी। वानिकी क्षेत्र में नई प्रौद्योगिकियों का विकास होने से इस विचार में परिवर्तन करने की आवश्यकता हो गई है, इसके अतिरिक्त छोटे किसान तक को लघु प्रकाष्ठ और ईंधन की आवश्यकता पूरी करने के मामले में आत्मनिर्भर बनाना होगा। प्रस्तुत अभिपत्र में एक मॉडल रोपवन बतलाया गया है जिसे छोटे और सीमांत कृषि करने वाले किसान लोग अपना सकते हैं जिनके लिए, वृक्षों के लिए लम्बे समय तक ठहरे रहना संभव नहीं है। अधिक सघनता वाला रोपवन लगाने के लाभ, उसे 0.4 हैक्टेयर भूमि पर लगाने की रूप सज्जा, इसे लगाने पर होने वाला संभावित व्यय, छोटे और सीमांत कृषि करने वाले किसानों के लिए ऋण की आवश्यकता तथा निर्वाह भत्तों की जरूरत में तथा उसकी जरूरत में न होने वाले कृषकों के लिए ऋण की अदायगी की अनुसूची का इस अभिपत्र में विवेचन किया गया है।

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अब छटे वर्ष में—

अधिक राशियों सहित

वन अनुसंधान संस्थान एवं महाविद्यालय, देहरादून

के

अखिल भारतीय वानिकी साहित्य पुरस्कार, 1983

वानिकी विषयों पर मूलतः हिन्दी में लिखित वैज्ञानिक व तकनीकी ग्रन्थों और लेखों को देय

ग्रन्थ पुरस्कार :	श्रेष्ठ लेखन पुरस्कार	5,000 रु०
	उत्तम लेखन पुरस्कार	3,000 रु०
	सराहनीय लेखन पुरस्कार	1,000 रु०
लेख पुरस्कार :	श्रेष्ठ लेखन पुरस्कार	500 रु०
	उत्तम लेखन पुरस्कार	350 रु०
	सराहनीय लेखन पुरस्कार	200 रु०
	प्रोत्साहन पुरस्कार	100 रु०

प्रविष्टियां 31 जुलाई, 1983 तक स्वीकार्य

विहित आवेदन प्रपत्र, नियम व विवरण अपना पता लिखा व बिना टिकट लगा 10 सेंमी० × 25 सेंमी० आकार का लिफाफा भेजने पर निम्न से 15 जुलाई 1983 तक प्राप्य ।

दुर्गाशंकर भट्ट
सचिव
अ०भा० वानिकी साहित्य पुरस्कार योजना,
वन अनुसंधान संस्थान एवं महाविद्यालय,
डा०घ० न्यू फारेस्ट (देहरादून) 248006

RESEARCH NOTE

DISTRIBUTION OF SOME PLANT COMMUNITIES WITH RESPECT TO GEOLOGY AND PHYSIOGRAPHY IN MUSSOORIE AREA

The role of geology and physiography in the distribution of plant species has been well recognized. However, sporadic work (Dhar and Jha, 1978) in this field has been done in the Himalanyan region. Rocks of Mussoorie belong to the tertiary age and have been classified under Krol and Tal formations (Auden, 1935). The physiography of the area is marked by moderate to very steep slopes, deep valleys, small streams and terraced fields. The following are the main points brought out as a result of the above study :

1. In the lower Krol zone in which pure limestone is predominating (high $CaCo_3$, content), grassland, scrub vegetation and a few places *Cupresses* (Sparse) and Ban Dak (*Quercus incana*) is present. This zone also supports *Cactus* and *Agave* sp. which at places, grows on bare rock. This zone is marked by terraces and moderately steep slopes.

2. The upper Krol zone (limestone and shales) supports a majority of Ban Dak forests. Ban often forms pure and gregarious species of high forest in this zone, Ban Dak is also mixed with single forms or small patches of *Xolism ovalifolia, Cronus macrophylla, C. oblonga, Pyrus pashia, Ilex dipyrena, Aseculus indica, Carpinus vimines, Celtis tetrandra, Rhus punjabensis, Myrica nagi, Euonyous pendulus* etc. in this formation.

In damp shady sites (near Benog) Ban Dak looses its predomination to a dense association of *Machilus* sp., *Phobe lanceolata* and *Acer* sp., often mixed with *Cedrela serrata*, Pure patches of *Cedrela* sp. occur at very moist sites near Benog and Kimoin. At higher altitudes (of this zone) in moist, shady depressions *Querecus floribund* and *Q. glauca* occur very sparsely. *Carpinus* sp. and *Alnus* sp. occur in moist areas and along water courses in this formation particularly near Dhobighat.

Chir Pine *(Pinus roxburghii)* is occurring at a few places in this zone. Here the soil tends to be low in $CaCo_3$ content clayey in texture and shallow in depth. It has been observed, at a place about 1 km SSE of Hathipaon, that roots of a Chir tree pass into shale/ phosphoritic horizon to avoid pure limestone.

3. In areas of higher elevation, (around Landour Cantonment) the lower Tal formation (mainly shale and clayey rocks) has produced a heavy textured soil. Both the Tal zones are characterised by monderate to steep slopes and rugged topography. Oak (pure and mixed) and upto a certain extent Chir has flourished. Ban Dak shows best development in moist sheltered slopes on northern aspects. On hotter exposed slopes, the forest is of a poor quality.

With altitude, the ban Oak is changing to a mixture of Kharsu Oak *(Q. semecarpifolia)* and its associates. At some places, these Oak forests form a relatively close canopy, which has given rise to a distinct layer of humus in the soil overlain by a few centimeters of undecomposed leaf litter.

In the moist shady slopes in the upper reaches, Blue Pine *(Pinus wallichiana)*, Deodar and a few trees of Silver fir *(Abeis pindrow)* are occurring. These are more common on the moister northern aspect.

4. The upper Tal zone (mainly quarzites etc.) has given rise to good Chir Pine forests. It is a well known fact that Chir Pine flourishes on rocks of silliceous composition. Chir Pine is well developed near Jabarkhet about 4 kms east of Mussoorie. Chir Pine forests are occurring as pure species or mixed with patches of Blue Pine, Deodar, and some Silver Fir and Spruce *(Picea smithiana)*.

On moister aspects, Kharsu Dak *(Quercus semecarpifolia)* and *Rhododendron arborem* are occurring, particularly in the east of this zone.

S. S. Negi
Asstt. Conservator of Forests
Rajgarh Forest Division
Rajgarh, (H.P.)

References

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LETTERS TO THE EDITOR

I

To,

The Honorary Editor,
Indian Forester,
P.O. New Forest
Dehra Dun.

Sub : **Albino seedlings**

Sir,

I have noticed albino seedlings of *Pongamia pinnata* in Kanpur nursery. In several polypots containing two seedlings one was albino and the other was of normal green colour. Analysis of the two leaves showed that the albino leaves contained less nitrogen in comparison to the green leaves.

Yours faithfully,

Sd./- A.N. Chaturvedi
Conservator of Forests,
Research & Development Circle,
Lucknow (U.P.)

(II)

To

The Honorary Editor,
Indian Forester,
P.O. New Forest, Dehra Dun.

Sub :- **Pruning in *Diospyros melanoxylon* Roxb.**

Sir,

D. melanoxylon is an important economic tree of tropical dry deciduous mixed forests of central India. Its leaves are plucked and used as 'Wrappers' for the manufacture of 'bidis' in bidi industries, hence contribute a significant amount of revenue to various states of our country.

Pruning in *D. melanoxylon* plays an important role for increasing the qualitative and quantitative production of bidi leaves.

Average number of newly emerged branches per stump was found to be increased from 21 (control) to 84 in February pruning however the size of branches was increased from 8 cm (control) to 58 cm in December pruning. The average number of new leaves per branch was also increased from 6 (control) to 19 having an increase in size from 9.5×6 cm to 17.5 to 10 cm in trees, which were pruned in December.

The normal and natural leafing of *D. melanoxylon* starts from April and continues upto June by producing, 400 quality leaves per tree, but if subjected to pruning in February, the number of quality leaves was increased to 1092/tree. Beside the normal leaf-crop in April-May, two additional leaf-crops can also be obtained if the pruning is performed systematically as under :

(a) Trees should be pruned in begining of each month from April to June and leaf-crop harvested at the end of each month.

(b) Trees should be pruned in June-July and leaf crop harvested in September, however the quality leaves available are very few.

The percentage of insect-galls and insect-bores on leaves was also found to be minimum in trees, which were pruned between December and April.

From the present study it appears that pruning is found to be most successful towards increasing qualitative production and minimising the insect-galls and insect-bores, if perform between the period of December and April.

Yours sincerely

Sd./– Dr. C. D. Athaya
Research Associate,
Department of Botany,
University of Saugar,
SAGAR (M.P.)

REVIEW

Termites of Sabah by R.S. Thapa, 1982. 374 pages, Sabah Forest Record Number, 12. State Forest Department, Sandakan, East Malaysia.

Termite fauna of Borneo Island of which Sabah forms the north-eastern part has been meagerly studied and published literature on this subject is scattered. 'Termites of Sabah' is the first comprehensive work written for this territory. It provides a detailed systematic account of termites of north-eastern part of Borneo, which includes 103 species and sub-species. Of these 38 are new to science. Sabah termites are represented by 33 genera belonging to 4 families. After a key of termite families, keys to genera are followed family-wise; keys to species of each genus are separately given under that genus. For description of species only that of imago and soldier castes have been taken and description of some imago castes have been reproduced verbatim or, if originally written in German or French their English translation, which makes the descriptive account of each species more comprehensive, and would no doubt serve a handy reference book for future research workers who may not have an easy access to these descriptions which have been published in old and rare books and journals. Exclusion of description of worker caste appears a snag but perhaps has been omitted for the obvious reason that every species has soldier caste and in none of the genera the worker caste at species level are significantly differentiated. References on each species are also well documented. The text is enriched by 130 figure plates of line drawings drawn with meticulous care by an artist who evidently loves the work. The get up of the book is very attractive and printing is excellent.

One of the striking feature, of the publication as the collection data shows, is that the author have made extensive survey of the termites of Sabah territory. The book is an expert treatise on termites of Sabah and fills up a long-felt gap in the faunal study of this part of the World. The book is a must for all termite research workers of the Oriental region. I congratulate the author and the forest department of Sabah for their efforts in bringing out this publication. Incidently it may be mentioned that the study material was collected by the author during the period of his deputation (1966-1970) under the Colombo plan assignment in connection with the Cerambycid borer problem in Dipterocarp forests in Sabah.

P. S.

GAZETTE NOTIFICATIONS

U.P. GAZETTE

Shri Hans Raj Ravi, Assistant Conservator of Forests is transferred from Research and Development Circle to Social Forestry Directorate in the Interest of public service.

WEST BENGAL GAZETTE

1. The Governor is pleased to allow Shri S. Palit, IFS, Conservator of Forests, Soil Conservation Circle to hold, in addition to his own duties, the charge of Divisional Forest Officer, Planning and Statistics (Planning) with effect from 25.1.83 till he is relieved of his additional charge by Shri M.K. Nandy, IFS.

2. The Governor is pleased to appoint, until further orders, Shri T.K. Mitra, IFS, Managing Direetor, West Bengal Forest Development Corporation Ltd. as dditional Chief Conservator of Forests, West Bengal, with effect from the date of his assuming charge.

3. The Governor is pleased to direct that Shri T.K. Mitra, IFS, will continue to be a Director of the West Bengal Forest Development Corporation Ltd. and will also hold in additioh to his own duties of Additional Chief Conservator of Forests, West Bengal, the charge of Managing Director, West Bengal Forest Development Corporation Ltd., until further orders.

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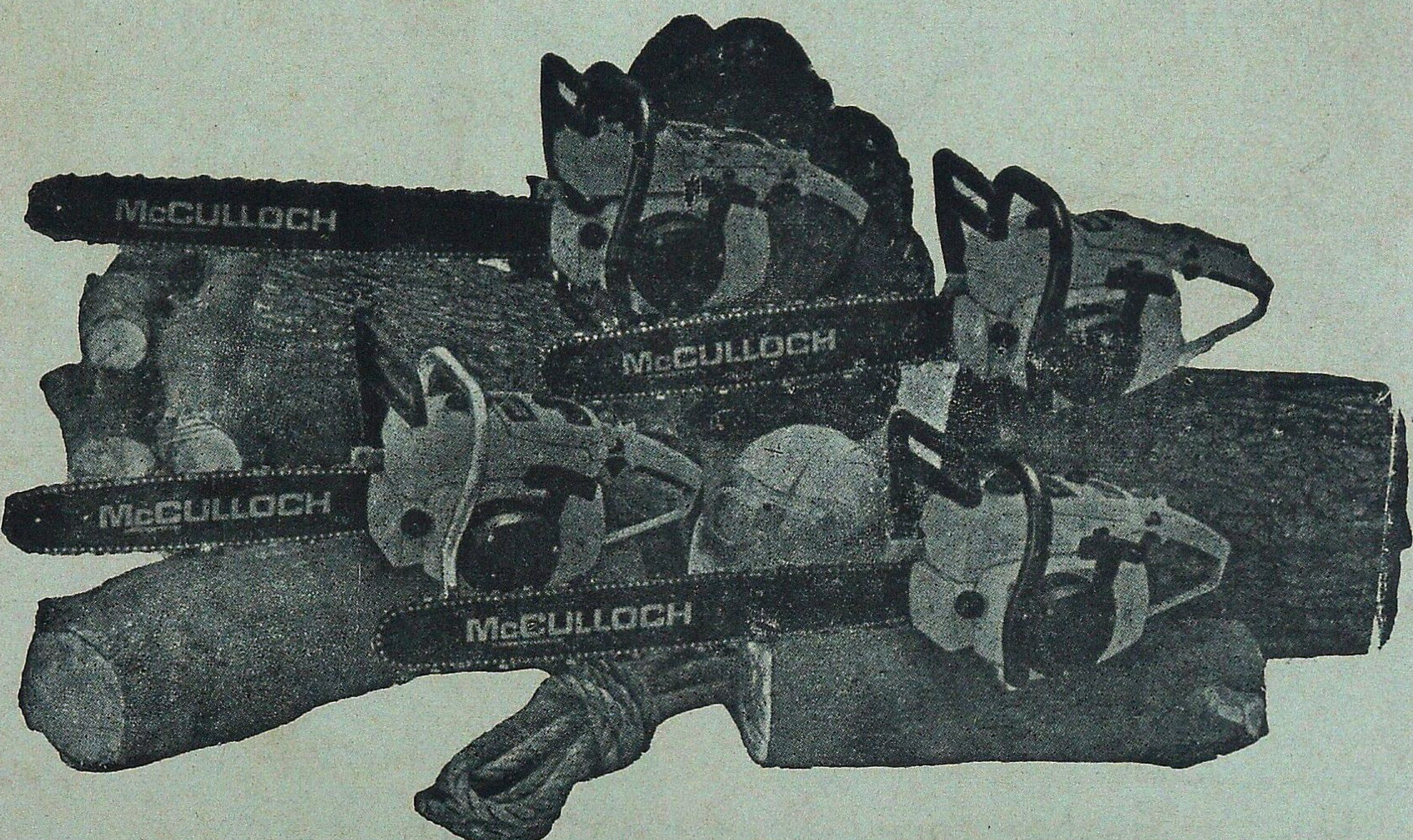

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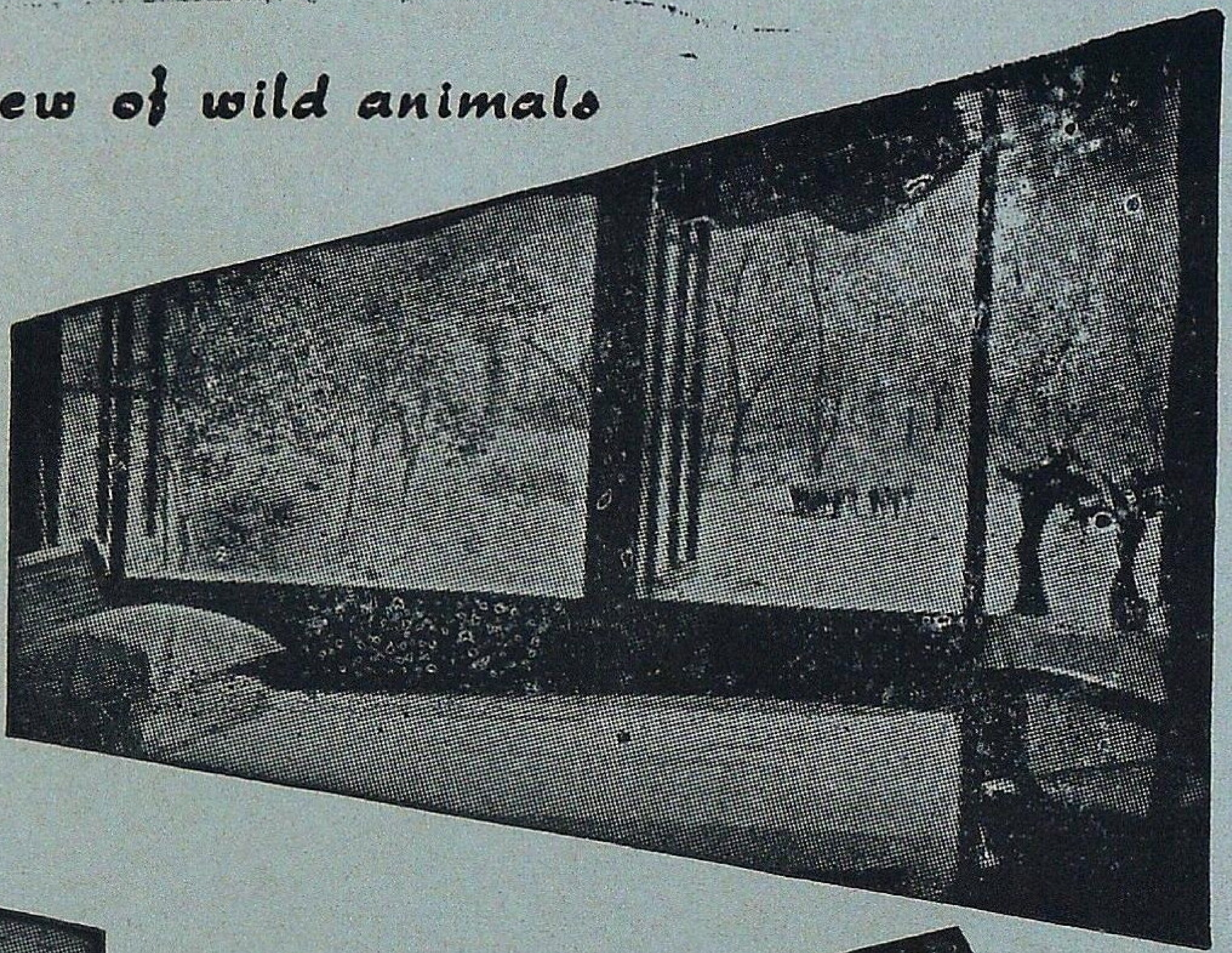

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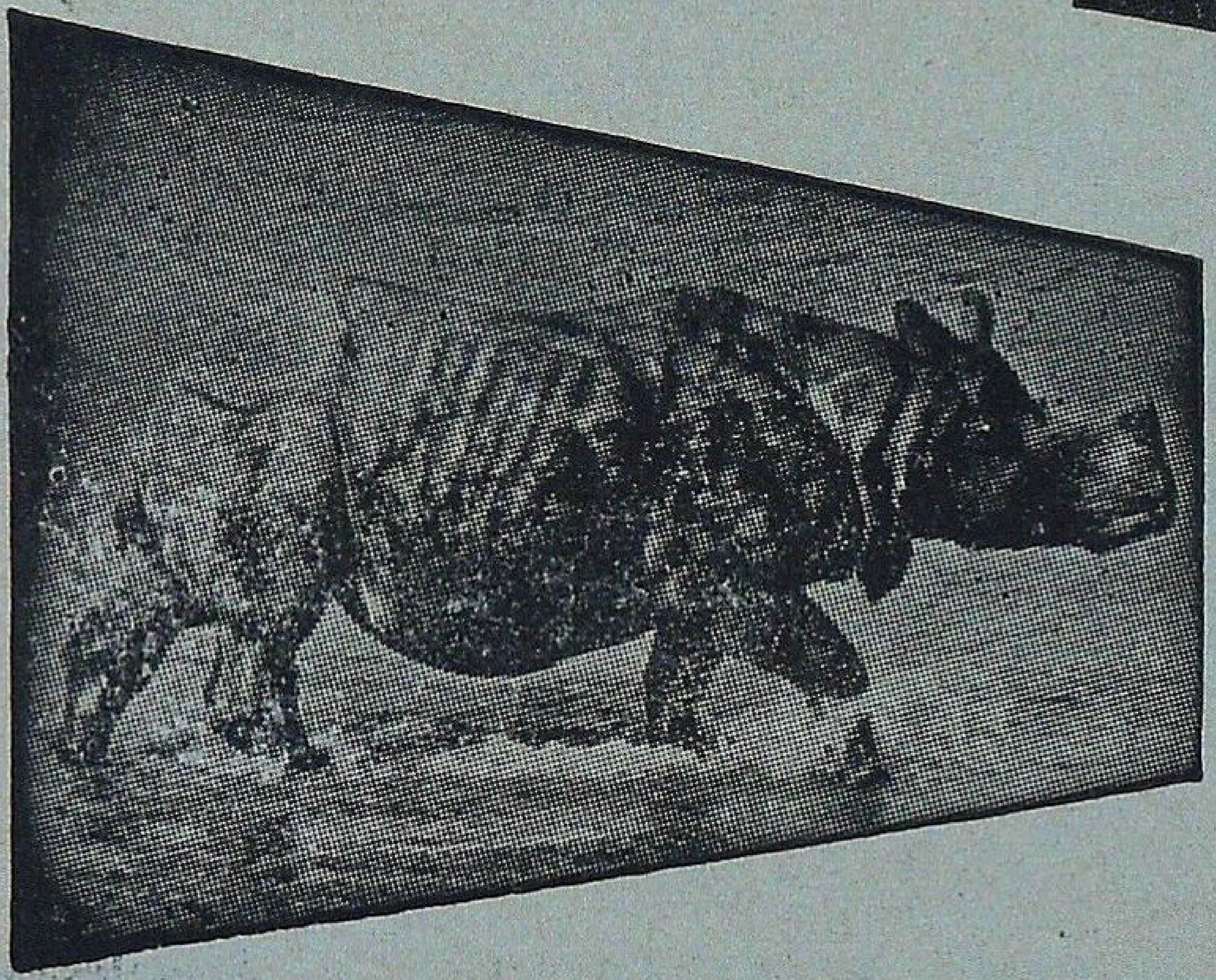

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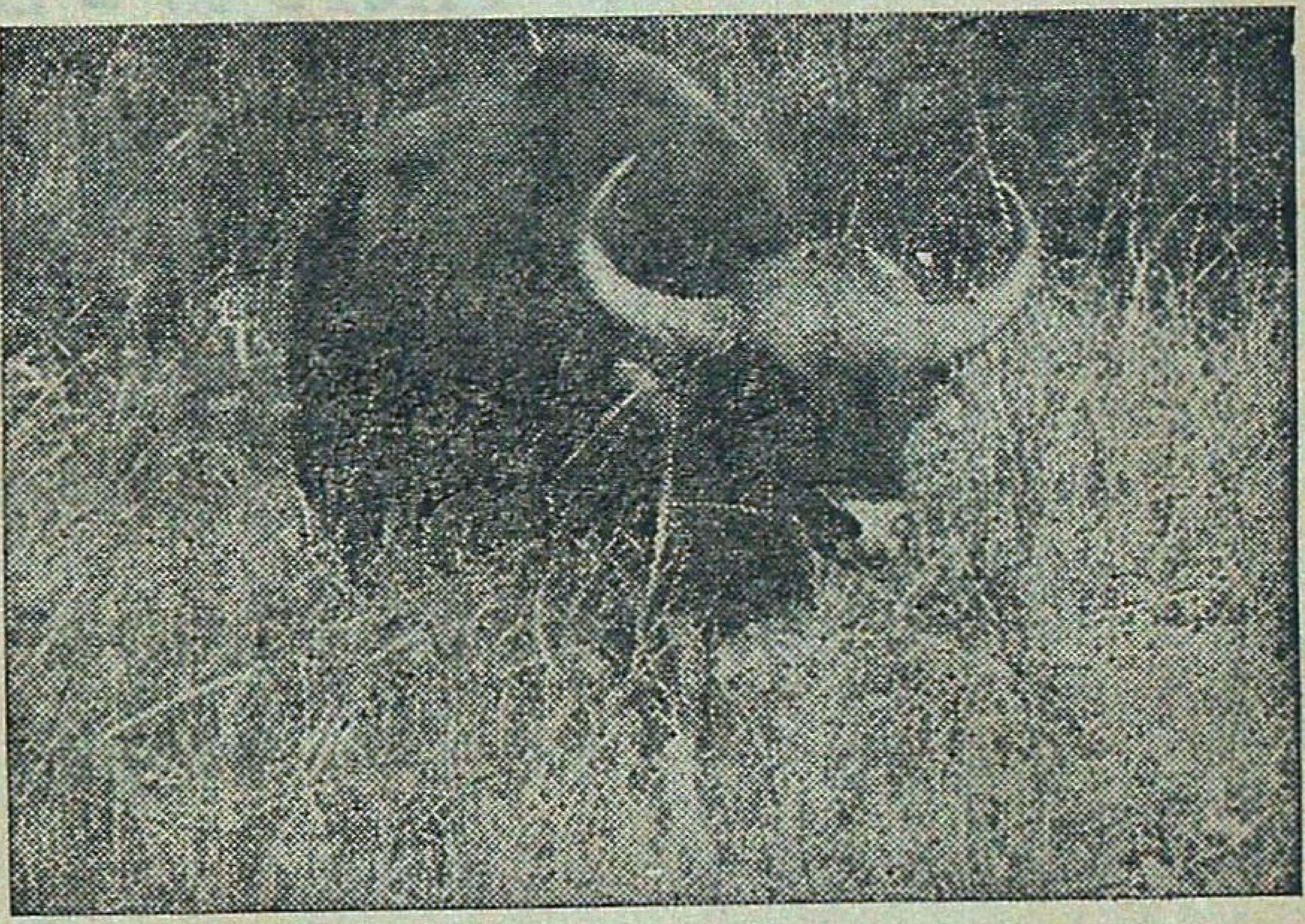

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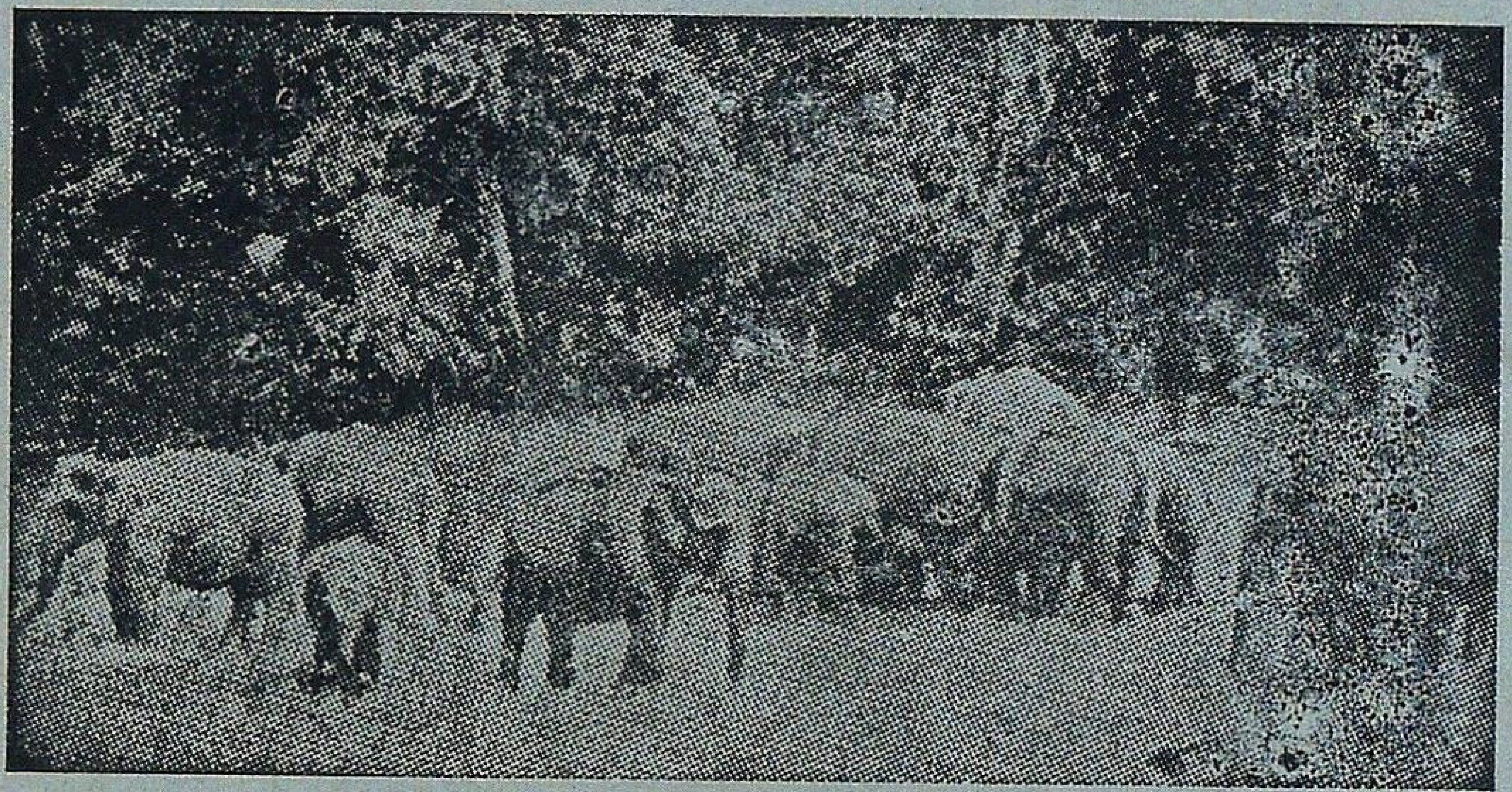

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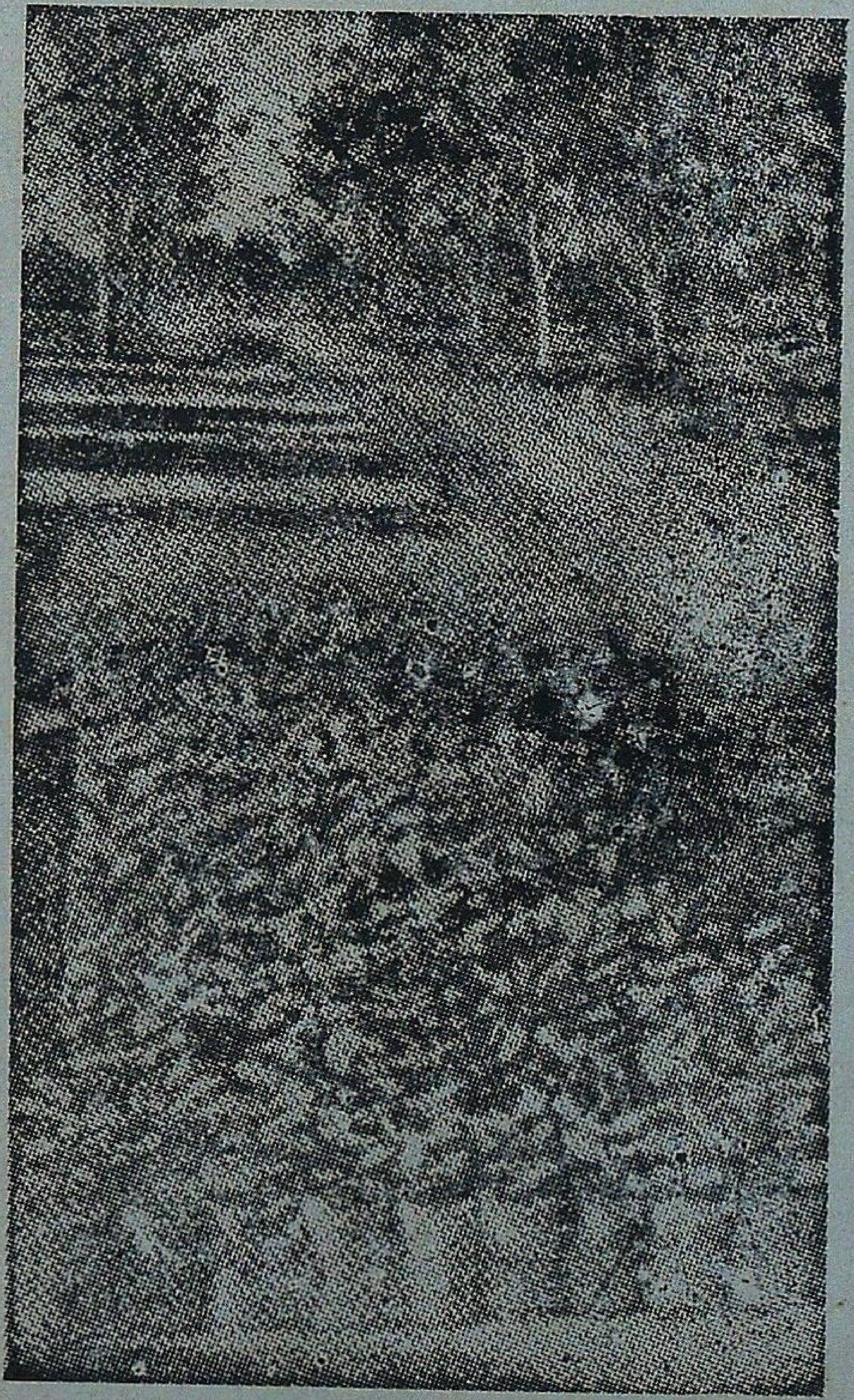

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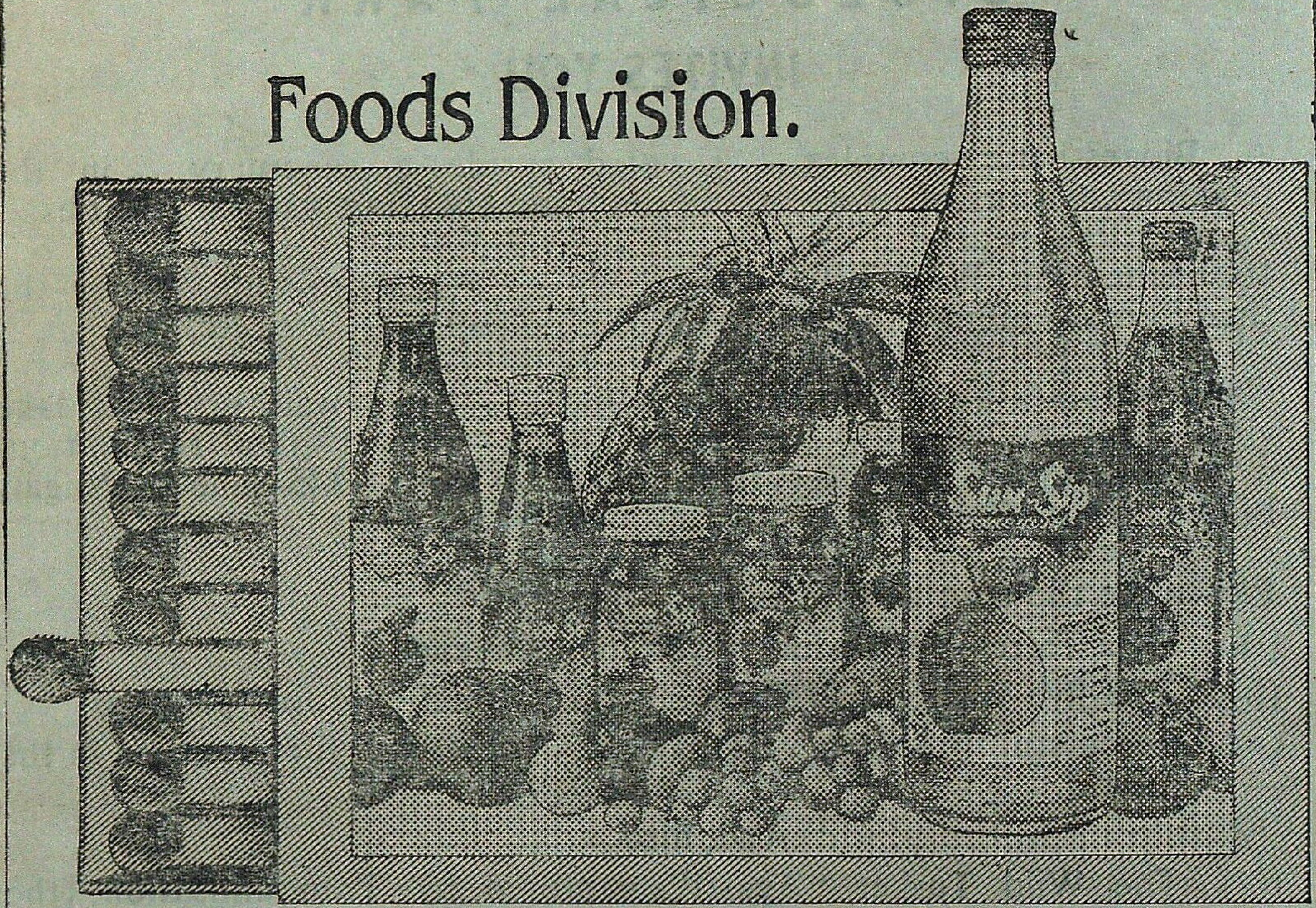

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Photo -- Pratap Singh. Front Cover

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